scanned

AN 08-40BC638-2

Handbook

Maintenance Instructions

FREQUENCY METER

BC-638-A

REVISION NOTICE

LATEST REVISED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert revised pages into basic publication. Destroy superseded pages.

TABLE OF CONTENTS

Section		Page
	DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE	iii
	UNSATISFACTORY REPORT	iii
I.	GENERAL DESCRIPTION	
	1. General	1
	2. Components	1
	a. Equipment Supplied	1
	b. Equipment Required but not Supplied	1
	3. Description	1
	4. Power Requirements	3
	5. Tube Complement	3
II.	INSTALLATION AND ADJUSTMENT	
	1. Installation	3
	a. Installation in Rack Mounting	3
	b. Installation in Case CY-33/CRC-2	3
	2. Connection to Power Supply	3
	a. Connection to Alternating Current	3
	b. Connection to Battery	3
	3. Preparation for Use	4
	a. Vacuum Tubes	4
	b. Fuses	5
	c. Tuning Chart	5
	d. Preliminary Adjustments	5
III.	OPERATION	
	1. Operation of Frequency Meter BC-638-A	5
IV.	MECHANICAL and ELECTRICAL CHARACTERISTICS	
	1. Power Supply Circuit	7
	2. Radio Frequency Circuit	7
	3. Electron Ray Indicator Tube	8
V.	MAINTENANCE	
	1. General	9
	2. Operational Inspection	9
	3. Disassembly of Unit	9
	a. Power and Antenna Connections	9
	b. Removal of Frequency Meter BC-638-A from Rack	9
	c. Removal of Dust Cover from Chassis	9
	d. Removal from Case C5-132	9
	e. Removal from Case CY-33/CRC-2	9
	f. R-F Tuning Unit	9
	4. Reassembly of Unit	12
	5. Routine Inspection and Overhaul	13
	a. Frequency Meter	13
	b. Tubes	13
	c. Tuning Capacitors	13
	d. Tuning Mechanism	13
	6. Inspection After Overhaul of Equipment	13
	7. Lubrication	13
	8. Location and Remedy of Faults	13
	a. General	13
	b. Trouble Location and Remedy	13
	c. Symptoms and Probable Causes	14
	9. Voltage and Resistance Measurements	15
	a. Tube Socket Resistance Measurements	15
	b. Tube Socket Voltage Measurements	15
	c. Power Transformer Voltage Measurements	16
	10. Alignment and Tracking Procedures	16
	a. Gear and Tuning Capacitor Alignment	16
	b. Tracking Procedure	17
	c. Method A	17
	d. Method B	17
	e. Final Adjustment	20
	11. Replacing Defective Components	20
	12. Over-all Performance Test	20
	a. General	20
	b. Standard Test Conditions	20
	c. Methods of Measurement	21
	13. Vacuum Tube Replacement	21
	14. Dial Light Replacement	21
VI.	TABLE OF REPLACEABLE PARTS	23
VII.	DRAWINGS	31

★

LIST OF TABLES

Table		Page
I.	Tube Socket Resistance Measurements	15
II.	Tube Socket Voltage Measurements	16
III.	Color Codes	22

★

LIST OF ILLUSTRATIONS

Figure	*Page*
1. Frequency Meter BC-638-A, Front View, Antenna in Place	iv
2. Frequency Meter BC-638-A, Front View	1
3. Frequency Meter BC-638-A, Navy Adaptation, Table Mounted in Case CS-132	2
4. Frequency Meter BC-638-A, Top View	4
5. Frequency Meter BC-638-A, Rear View, Dust Cover in Place	4
6. Frequency Meter BC-638-A, Rear View, Dust Cover Removed	6
7. Frequency Meter BC-638-A, Top View, Showing Removable Portion of Dust Cover	6
8. Frequency Meter BC-638-A, Left Side View	7
9. Frequency Meter BC-638-A, Right Side View	7
10. Frequency Meter BC-638-A, Rear Oblique View, R-F Tuning Unit	10
11. Frequency Meter BC-638-A, Bottom View	10
12. Frequency Meter BC-638-A, Left Side View, R-F Tuning Unit	11
13. Frequency Meter BC-638-A, Right Side View, R-F Tuning Unit	11
14. Frequency Meter BC-638-A, Rear View, R-F Tuning Shield in Place	12
15. Frequency Meter BC-638-A, R-F Tuning Unit Gear Assemblies	16
16. Frequency Meter BC-638-A, Gear and Dial Assembly	17
17. Frequency Meter BC-638-A, Top View, R-F Tuning Unit	18
18. Frequency Meter, BC-638-A, Rear View, R-F Tuning Unit	18
In back of book:	
19. Frequency Meter BC-638-A, Vacuum Tube Base Diagram	32
20. Frequency Meter BC-638-A, Wiring Diagram	33-34
21. Frequency Meter BC-638-A, Schematic Diagram	35-36

DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:-

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:-

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

★

UNSATISFACTORY REPORT

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Radio model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made from N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the Inspector of Naval Material, 1600 Arch Street, Philadelphia 3, Pa., U.S.A., and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

Form 1022 procedure should be used when reporting failure of radio equipment.

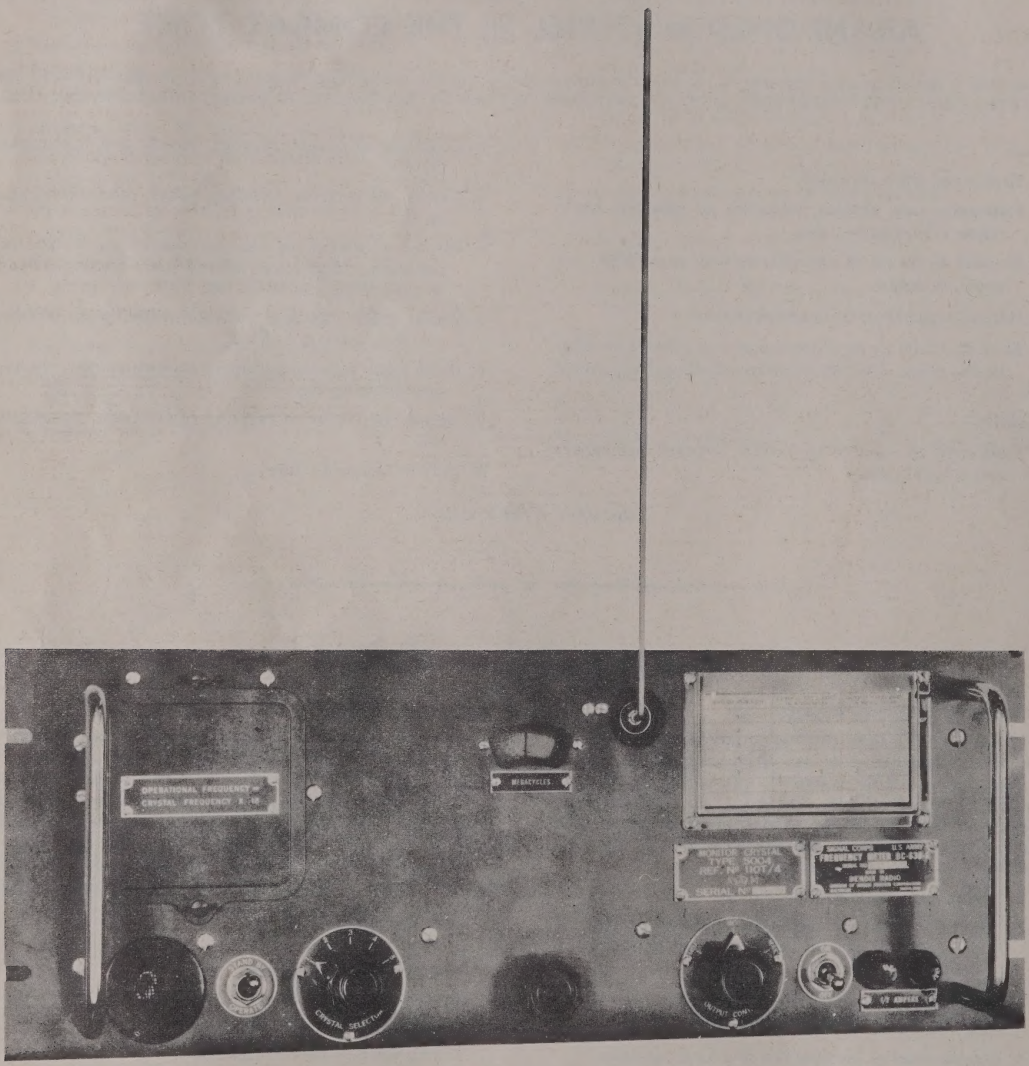


Figure 1 — Frequency Meter BC-638-A with Antenna in Place—Front View

SECTION I
GENERAL DESCRIPTION

1. GENERAL.

PURPOSE. — This handbook describes the operation and maintenance of Frequency Meter BC-638-A, which is used to preset, test, and align radio receivers (such as Radio Receiver BC-639-A) whose frequency range is within its frequency limits.

Frequency Meter BC-638-A is supplied and used with Radio Sets SCR-563, SCR-564, SCR-565, SCR-567, SCR-574-A, SCR-574-B, SCR-575-A, SCR-575-B, SCR-644-A, SCR-645-A, SCR-633, SCR-637, or AN/CRC-2. As a general rule, Frequency Meter BC-638-A is used with Radio Receiver BC-639-( ).

shelf-type chassis which is inclosed in a dust cover. All of its components are supported and its controls operated from the front panel, which is standard size for rack mounting. The frequency meter has its own self-contained power supply which operates from 110-120 or 200-250 volts alternating current 50-60 cycles.

b. FRONT PANEL.—The front panel of Frequency Meter BC-638-A contains the following controls, indicators, and receptacles: (See fig. 1.)

(1) CRYSTALS.—In the upper left hand corner of the panel there is provision for mounting six crystals in a recessed crystal socket mounting board,

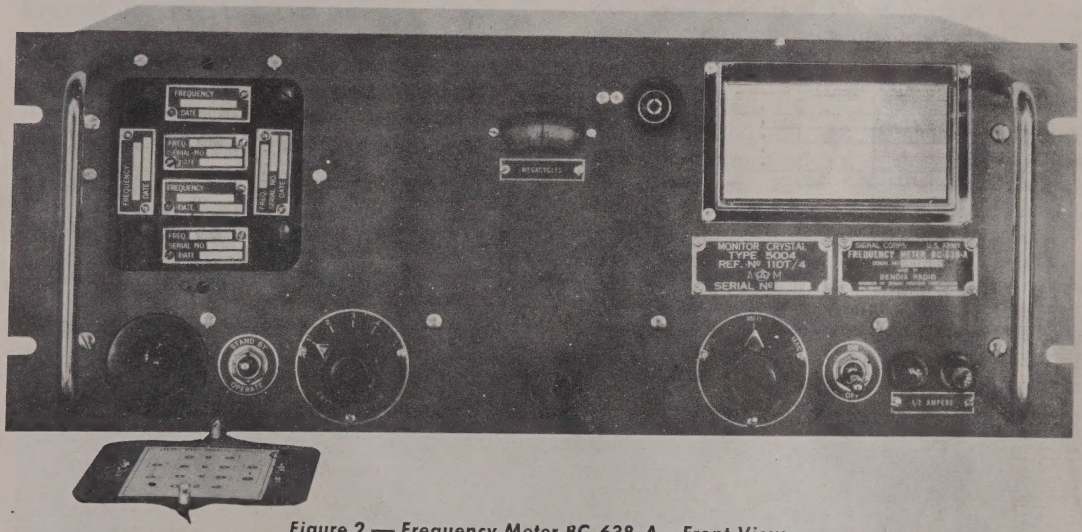


Figure 2 — Frequency Meter BC-638-A—Front View

2. COMPONENTS.

a. EQUIPMENT SUPPLIED. — One Frequency Meter BC-638-A, weighing 35 lbs., 7 by 19 by 11½ inches and complete with a-c power supply, tubes, and the rod antenna, is supplied.

b. EQUIPMENT REQUIRED BUT NOT SUPPLIED.—This includes Crystal Units DC-11, DC-16, or CR-1B/AR.

3. DESCRIPTION.

a. GENERAL. — Frequency Meter BC-638-A is a crystal-controlled signal generator with a frequency range of 100 to 156 megacycles (3 meters to 1.92 meters). It is tone-modulated approximately 30 percent at 1000 cycles The entire unit is mounted on a

covered by an auxiliary cover, removable from the front. To remove this cover, turn the screws at the top and bottom a quarter turn to the left. It can then be pulled off. (See fig. 2.) There are six crystal sockets, but only five are connected into the circuit; the sixth socket is a spare. These sockets are clearly identified by number. Any one of the five crystals may be introduced into the circuit by means of the five-position "CRYSTAL SELECTOR" switch located near the left bottom of the panel.

(2) TUNING CONTROL.—The tuning control is in the center near the bottom. This control drives the five tuning capacitors for a complete coverage of the frequency band (100-156 megacycles). The dial

is calibrated directly in megacycles, and the scale moves behind a window marked "MEGACYCLES," above the control knob. This scale is indirectly lighted by a dial light.

(3) ELECTRON RAY INDICATOR TUBE.—An electron ray indicator tube, or "magic eye" as it is more commonly called, is located in the lower left hand corner. Its end is visible through a small screen. This tube serves to provide an accurate visual means of tuning the unit.

(4) FUSES.—Two fuses are located in the lower right hand corner of the front panel. These are provided in the a-c input power line. Each may be removed from its holder by unscrewing the bakelite cap marked "FUSE." As indicated on the plate below them, ½-ampere fuses are used.

(5) "ON-OFF" SWITCH.—To the left of the fuses is a two-position toggle switch labeled "ON-OFF." This switch controls the application of power to the unit, regardless of whether alternating current or battery power is used.

(6) "OUTPUT CONTROL" SWITCH. — The "OUTPUT CONTROL" is a three-position switch on the lower right side of the front panel. The three positions, "MIN," "MED," "MAX," give three degrees of generated signal output.

(7) "STAND BY-OPERATE" SWITCH.—In the lower left corner of the front panel is a two-position toggle switch marked "STAND BY-OPERATE." In the "STAND BY" position the frequency meter is inoperative, since the plate power supply is open, but the tube filaments are kept energized so that the unit may be instantly placed in operation when desired. In the "OPERATE" position all power is applied and the frequency meter is functioning normally.

(8) "CRYSTAL SELECTOR" SWITCH.—In the lower left corner of the front panel (next to the "STAND BY-OPERATE" switch) is the "CRYSTAL SELECTOR" switch. This is a five-position switch, each position corresponding to one of the five crystals. Any one of the five crystals may be switched into the frequency meter circuit by turning it to the appropriate position.

(9) TUNING CHART.—In the upper right corner of the front panel is a chart divided into three columns:

(a) "SWITCH POSITION" indicates the number of the crystal being used (as selected by the "CRYSTAL SELECTOR" switch).

(b) "CRYSTAL FREQUENCY IN KILOCYCLES" indicates the fundamental frequency (as marked on the crystal holder) of the crystal indicated in the first column.

(c) "OUTPUT FREQUENCY IN MEGACYCLES" indicates in megacycles the output frequency of the frequency meter. To obtain this frequency, multiply the crystal frequency (shown in the second column) by 18.

(10) ANTENNA SOCKET.—The antenna socket is located near the top of the front panel next to the tuning chart. This socket (see fig. 2) may be used either for a coaxial cable plug or a rod antenna. A small rod antenna 12½ inches long with a fitting to plug into the antenna socket is supplied with the frequency meter. When the unit is shipped, this rod is located at the rear of the chassis under the dust cover. (See fig. 4.)

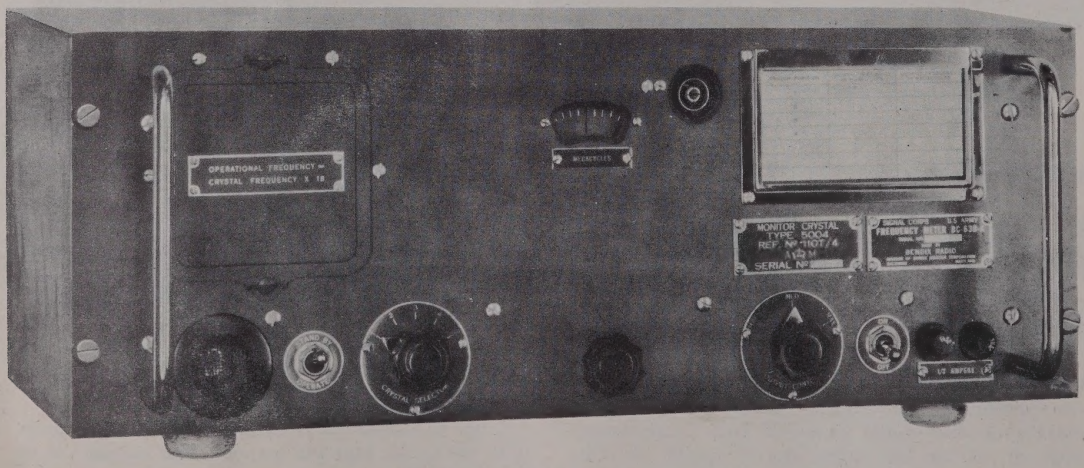


Figure 3 — Frequency Meter BC-638-A, Navy Adaptation, Table Mounted in Case CS-132

c. TABLE-MOUNTED FREQUENCY METER. — Table-mounted Frequency Meter BC-638-A (see fig. 3) is the same as the rack-mounted frequency meter except that it is mounted in Case CS-132 which is supported on four Lord shockmounts and is held in place by four knurled thumbscrews located two on each side of the case. These screws are not removable; they are held in slots in the case by "C" washers. This case replaces the dust cover used with the rack-mounted frequency meter. This table-mounted model is used chiefly in Naval installations and is not ordinarily used by the Army Air Forces.

4. POWER REQUIREMENTS.

a. The primary power supply requirements are 50-60 cycles, single-phase alternating current, 30 watts, 110 to 120 volts or 200 to 250 volts. Voltage changes are made by taps on the power transformer primary. The tap is normally connected for operation at 220 volts alternating current and, when shipped from the manufacturer, is wired for operation at this voltage. If other line voltages are used, the tap must be reconnected for operation.

b. Frequency Meter BC-638-A may also be operated from a 6-volt storage battery in conjunction with Dynamotor Unit PE-100-A; however, this is not the normal procedure. The plate circuits in Frequency Meter BC-638-A require approximately 205 volts at a current drain of 25 milliamperes, and the filament circuits require 6.3 volts at a current drain of 1.45 amperes. When Dynamotor Unit PE-100-A is used to supply the necessary potentials, it draws a current of approximately 6.0 amperes from the 6-volt battery.

c. A concentric line or direct pickup from the rod antenna normally feeds the output of the meter to the radio receiver. Either the rod antenna or the concentric line may be inserted into the antenna socket on the top front of the panel.

5. TUBE COMPLEMENT.

Quantity	*Mfr. Type*	*Name*	*Signal Corps Type*
1	6SK7	Triple-grid super-control amplifier	VT-117
2	9003	Semi-remote cutoff pentode	VT-203
1	9002	Triode	VT-202
1	6E5	Electron ray tube	VT-215
1	6L5G	Detector-amplifier triode	VT-213-A
1	5V4G	High vacuum rectifier	VT-206-A

SECTION II
INSTALLATION AND ADJUSTMENT

1. INSTALLATION.

a. INSTALLATION IN RACK MOUNTING.

(1) Grasp the frequency meter by the handles on the front panel (fig. 1) and slide it into its standard rack mounting. It is held in place by four #10-32 fillister-head screws.

(2) A lock washer and flat washer are located under the head of these four screws. Be sure that the flat washer is placed next to the panel.

(3) All outside connections to the frequency meter are made to antenna socket 457 on the front panel (see fig. 1) and to either the a-c power supply inlet or the dynamotor lead terminals at the rear of the chassis. (See fig. 6.)

(4) The frequency meter is used with either a concentric line or the 12½-inch rod antenna. Either may be inserted into the antenna socket 457 on the front panel.

b. INSTALLATION IN CASE CY-33/CRC-2. — Case CY-33/CRC-2 is part of Radio Set AN/CRC-2. When using Frequency Meter BC-638-A in connection with this radio set, mount it in this case as follows:

(1) Grasp the handles located on the front panel of Frequency Meter BC-638-A.

(2) Slide the unit from the front as far as it will go into the case. The brackets on the bottom of the unit fit on a grooved wooden track.

(3) Tighten the four knurled screws on the front panel.

(4) The frequency meter uses a dust cover when mounted in a relay rack and Case CY-33/CRC-2 when shockmounted to a table.

2. CONNECTION TO POWER SUPPLY.

There are two receptacles for power supply (456-1 and 456-2) located beneath the dust cover on top of the chassis at the rear of the frequency meter. These receptacles are marked "BATTERY" and "LINE." The selection of either of these power supplies is made with a Jones plug. (See fig. 4.)

a. CONNECTION TO ALTERNATING CURRENT.—To operate the frequency meter from the a-c line, insert plug 506 into the receptacle marked "LINE" (456-1) on the short cable fastened to the chassis. Insert the power plug into the a-c power receptacle at the right rear of the chassis.

b. CONNECTION TO BATTERY. — To connect the frequency meter to the "BATTERY" insert the

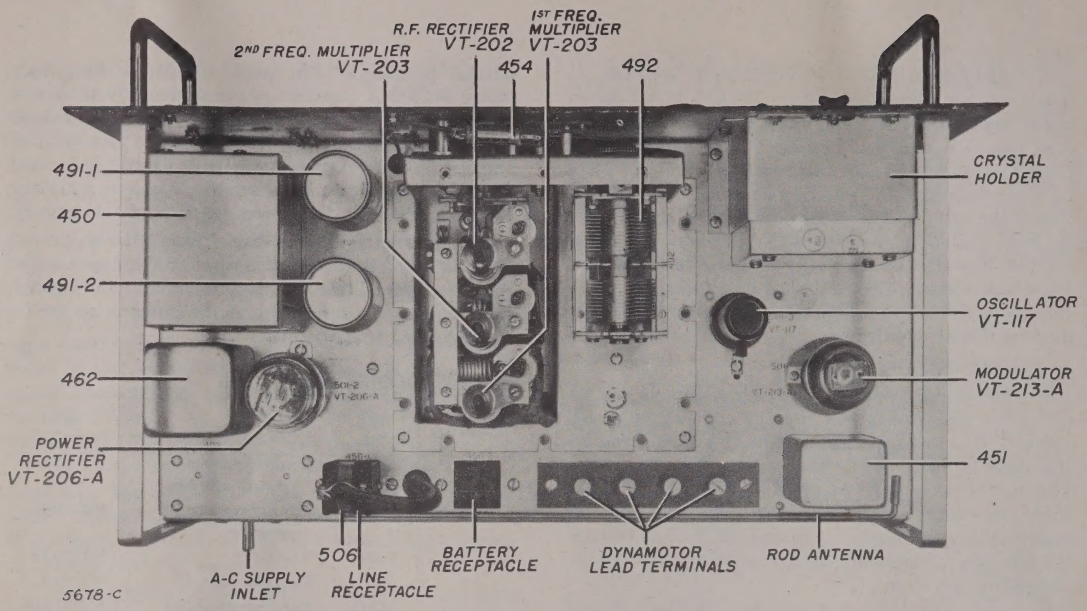


Figure 4 — Frequency Meter BC-638-A—Top View

plug on the short cable fastened to the chassis into the receptacle marked "BATTERY" (456-2). Remove the snap covers from the rear of the dust cover (see fig. 5) and connect the four battery leads from the four terminals at the top rear of the chassis, through the holes in the dust cover to Dynamotor Unit PE-100-A or other source of power. Make sure that polarity is observed and that the high and low voltage connections are properly made. (See *Handbook of Maintenance Instructions for Dynamotor Unit PE-100-A* for the connection to the primary power source.) On Frequency Meter BC-638-A the plus and minus low voltage terminals are connected to a 6.3-volt source of power. The plus and minus high voltage terminals are connected to a source which will supply from 180 to 210 volts direct current. These requirements are normally fulfilled by Dynamotor Unit PE-100-A.

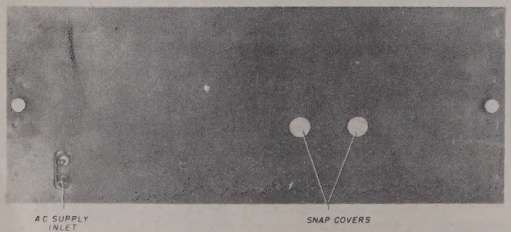


Figure 5 — Frequency Meter BC-638-A with Dust Cover in Place—Rear View

3. PREPARATION FOR USE.

a. VACUUM TUBES.—Check the position of all vacuum tubes before operating the frequency meter. This equipment is supplied with all vacuum tubes. Make sure that all are in their proper sockets by comparing the markings on the tubes with the markings next to the sockets. Rectifier Tube VT-206-A, high frequency oscillator Tube VT-117, and 1000-cycle oscillator modulator Tube VT-213-A are located on the chassis. (See fig. 6.) To locate these tubes remove the dust cover. One r-f rectifier Tube VT-202 and two Tube VT-203 frequency multipliers are located under the shield. To locate them, remove the dust cover and shield located at the center of the chassis. Remove the shield by unscrewing 12 screws, three screws on each side of the shield. Do not remove the four corner screws.

On later models of Frequency Meter BC-638-A, it is not necessary to remove the entire shield in order to reach these tubes. Merely remove the metal plate on top of the shield by unscrewing the four screws along the sides of the plate; the tubes will then be accessible through the opening. (See fig. 7.)

CAUTION

Take care in removing and replacing Tubes VT-202 and VT-203 as the glass seals around the tube leads and the air seal at the top are easily broken. The clamps over the tops of the tubes should fit firmly but not too tightly.

Electron ray Tube VT-215 is under the chassis and can be seen through the cover from the front of the panel. To replace the tube, remove the cover from the lower left of the front panel.

b. FUSES.—Check fuses before placing equipment in operation to see that they are in good condition and of correct size. Each fuse should be of ½-ampere capacity.

The two fuses are located in the lower right hand corner of the front panel. To remove them, unscrew the small knurled knobs marked "FUSE." Each fuse is held to its knob by a circular clip. Do not detach fuse if only inspecting it. If necessary to replace a damaged one, simply pull it out of the clip and insert a new fuse.

c. TUNING CHART.—Before operation, fill out the three columns on this chart with the correct data. (See sec. I, par. 3, *b,* (9).)

d. PRELIMINARY ADJUSTMENTS.—To prepare the frequency meter for use, proceed as follows:

(1) If a-c power is to be used, adjust the tap on transformer 450 which matches the line voltage (see sec. V, par. 9*c)* and insert the a-c power plug in the rear of the unit. (See fig. 5.)

(2) If battery power is to be used, connect the unit to Dynamotor Unit PE-100-A by means of four wire leads. (See fig. 4.)

(3) Connect either the concentric line or rod antenna to the antenna socket on the front panel. (See fig. 1.)

(4) Connect plug 506 located beneath the dust cover, into either the "BATTERY or LINE" receptacle. (See par. 2, this section.)

(5) If the unit is to be operated from an external power supply such as Dynamotor Unit PE-100-A, turn on the external switch for this supply.

(6) Insert the crystals into the crystal holder at the top left corner of the front panel.

(7) Frequency Meter BC-638-A is now ready for operation.

SECTION III
OPERATION

1. OPERATION OF FREQUENCY METER BC-638-A.

a. Place the "STAND BY-OPERATE" switch in the "STAND BY" position.

b. Turn the "ON-OFF" switch to the "ON" position.

(1) The dial indicator lamp should light.

(2) Allow at least 60 seconds for the tubes to heat properly.

c. Refer to the tuning chart near the upper right hand corner of the front panel.

(1) From the chart find the number of the crystal which will give the desired output frequency of the frequency meter.

(2) Turn the "CRYSTAL SELECTOR" switch to the position which corresponds to the number of the crystal desired.

d. Check to be sure the 12½-inch vertical antenna is tightly plugged into its socket and that it is not shorted to the panel.

e. Turn the "MIN-MED-MAX" switch to the "MAX" position.

f. Place the "STAND BY-OPERATE" switch in the "OPERATE" position.

g. Tune the knob directly below the calibrated dial to the desired frequency output. The dial reading will be approximately 18 times the crystal frequency, depending upon the accuracy of the dial calibration.

(1) The exact position of this tuning will be indicated by the indicator tube behind the circular screen near the lower left hand corner of the panel.

(2) Tune the dial for the smallest angle made by the dark green portion of this indicator.

h. The frequency meter is now radiating the exact frequency of the selected crystal multiplied by 18.

i. The signal now can be tuned in on a receiver such as Radio Receiver BC-639-A. If the signal strength is too great, it may be decreased by the "MIN-MED-MAX" switch.

j. To turn off the frequency meter but have it ready for instant use, turn the "STAND BY-OPERATE" switch to the "STAND BY" position.

k. To turn off the frequency meter completely:

(1) Place the "STAND BY-OPERATE" switch in the "STAND BY" position.

(2) Place the "ON-OFF" switch in the "OFF" position.

(3) If an external switch for a battery power supply is used, turn off this switch.

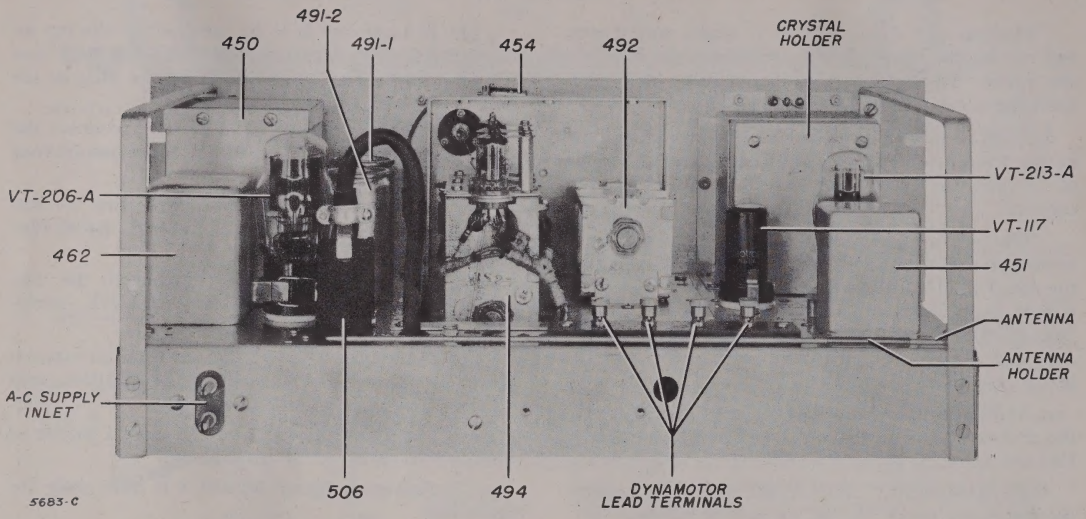


Figure 6 — Frequency Meter BC-638-A with Dust Cover Removed—Rear View

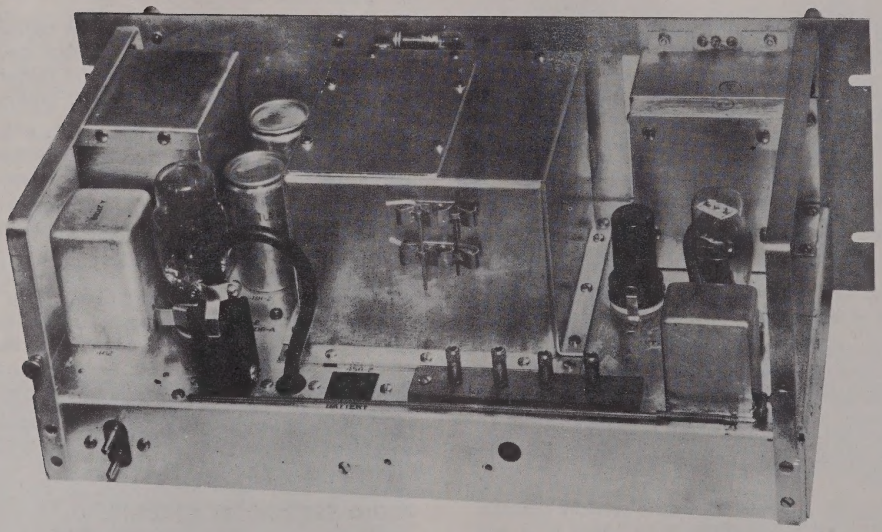


Figure 7 — Frequency Meter BC-638-A, Showing Removable Portion of R-F Dust Cover and Allen Wrench Holders—Rear View

SECTION IV
MECHANICAL AND ELECTRICAL CHARACTERISTICS

1. POWER SUPPLY CIRCUIT.

a. The a-c input to the unit is shown on the schematic diagram, figure 21, at the connections marked "LINE." The a-c line is connected to the power transformer through the radio frequency filter (capacitors 483-1, 483-2 and inductances 461-1, 461-2), through fuses 453-1 and 453-2, and the "ON-OFF" switch 458-2. In the symbol for power transformer 450, the potential which should be applied to the respective taps is indicated, for example, 220 volts as the connection is shown in figure 21. With one side of the line connected to terminal 2, the other side may be connected to various taps, making possible operation from 110, 200, 220, or 240 volts alternating current. If the side of the line connected to terminal 2 is connected to terminal 1, an additional difference of ten volts is obtained, (the −10 indicating a value of 10 volts below the terminal marked "0"). Thus, it is possible to operate also from voltages of 120, 210, 230 and 250 volts alternating current. The filament winding between terminals 10 and 11 is connected to socket 456-1 (terminals 13 and 15) which is located on top of the chassis near the rear. It is used for supplying filament power for all tubes in the unit with the exception of the power supply rectifier. The rectifier circuit is a conventional full-wave vacuum tube circuit. The d-c plate supply is connected through the "STAND BY" switch 458-1, and the pi filter, consisting of capacitors 491-1, 491-2, and filter choke 462, to terminals 14 and 16 on socket 456-1.

b. Along the rear edge of the chassis are four terminals marked plus and minus "L.V." and "H.V." (see fig. 4, "DYNAMOTOR LEAD TERMINALS") for the filament and plate supply respectively. The battery drain is approximately 25 milliamperes at 205 volts for the plate supply and 1.45 amperes at 6.3 volts for the filament supply. The "L.V." terminals connect to terminals 13 and 15 on socket 456-1 through the "ON-OFF" switch 458-2. The "H.V." terminals connect to terminals 14 and 16 on the same socket via the "STAND BY" switch 458-1. This socket is similar to and is connected like socket 456-1 described above.

At the rear of the chassis is plug 506 which is connected to the unit by a short cable. This plug is inserted into either socket 456-1, the line receptacle, or socket 456-2, the battery receptacle, depending upon whether alternating or direct current is used (see figs. 4 and 7). Two terminals on this plug are connected to the unit's filament circuit and dial light, and the other two are connected to the unit's plate circuit

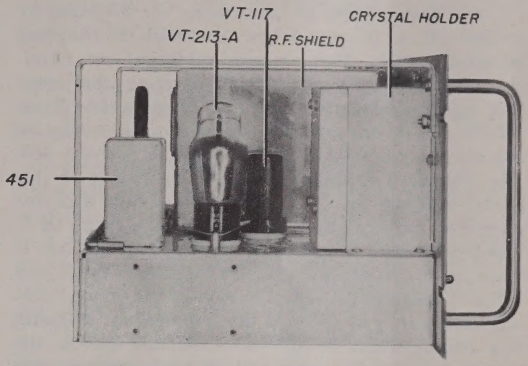


Figure 8 — Frequency Meter BC-638-A— Left Side View

through a pi network, r-f filter consisting of capacitors 480-4 and 480-5 and r-f choke 463-3. This completes the power supply circuit.

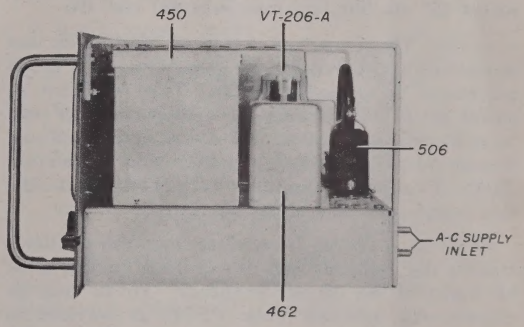


Figure 9 — Frequency Meter BC-638-A— Right Side View

2. RADIO FREQUENCY CIRCUIT.

a. The crystal oscillator in Frequency Meter BC-638-A is the conventional type of pentode crystal oscillator operating on its fundamental frequency, that is, the frequency of the crystal. Any one of the five crystals may be switched into the circuit by rotating the "CRYSTAL SELECTOR" switch 459 to the

number of the desired crystal. The plate circuit of the oscillator Tube VT-117 is shunt-fed, tuning capacitor 492 and coil 464 forming the tuned circuit. Coil 463-1 is the plate r-f choke, capacitor 481 is the blocking capacitor, and capacitor 499 is the coupling capacitor to the following stage.

(1) Two degrees of attenuation are provided by resistor 467, or 467 plus 479 in series with the coupling capacitor 499. This is in addition to maximum coupling obtainable by connecting the coupling capacitor directly to the grid of the second Tube VT-203. Any one of these three conditions can be selected by the "OUTPUT CONTROL" switch 460. The frequency appearing in the plate circuit of this second tube is 6 times that of its grid circuit; thus this stage multiplies the input frequency by a factor of 6. The plate circuit is series fed, and the tuned circuit is made up of inductance 465 and capacitors 494-A and 498-1. Capacitor 494-A is a section of the ganged tuning capacitor, and 498-1 is the trimmer for aligning this circuit with the others. Capacitor 487 is the coupling capacitor to the grid of the following tube, which is operated as a tripler.

(a) The plate circuit of this tripler Tube VT-203 is series fed, with inductance 466-2 and capacitors 494-B and 498-2 forming the tuned circuit. Capacitor 494-B is one of the sections of the ganged capacitor, and 498-2 is the trimmer capacitor. This tripler is also the output stage and is coupled to the output socket 457 via coupling capacitors 497 and 496.

(b) The plate and screen of the tripler are modulated approximately 30 percent at 1000 cycles per second by the audio oscillator Tube VT-213-A in socket 501-1. The Heising modulation circuit is used here, the coil between 1 and 2 on the audio oscillator transformer 451 making up the common modulation choke. Thus, this transformer 451 is both the oscillation transformer and modulation choke.

b. When a crystal is switched into the oscillator circuit, the oscillator and other tuned circuits must be tuned to the correct frequency. To do this, an electron ray indicator Tube VT-215 is provided to indicate exact resonance. However, to obtain this indication of resonance, an r-f rectifier must be incorporated to provide a controlling voltage for the grid of the electron ray tube. The r-f rectifier Tube VT-202 in socket 502-2 is a triode tube with its elements connected as a diode. The input circuit of the r-f rectifier is tuned by coil 466-1 and capacitors 494-C and 498-3. Capacitor 494-C is one of the sections of the ganged capacitor, and 498-3 is the trimmer capacitor.

c. Capacitor 486-3 prevents the diode current from flowing through the tuned circuit. Resistor 473 is the diode load; the r-f rectifier output appearing across this load is connected to the control grid of the electron ray indicator tube via resistor 474. This resistor aids in preventing radio frequencies and modulation frequencies from getting into the indicator tube circuit. Capacitors 480-1 and 482-3 appear to be in parallel but are necessary due to the long lead between the r-f rectifier tube and the electron ray indicator tube. Capacitor 482-3 is a small r-f bypass capacitor provided to keep radio frequencies out of this lead; it is located near the r-f rectifier. Capacitor 480-1 is located at the grid of the indicator tube and keeps radio frequencies and audio frequencies out of the indicator tube circuit.

d. All of the tuned circuits of the frequency meter are ganged together and controlled from the tuning control. The multiplying factor of the crystal frequency is 18, since the tube following the crystal oscillator multiplies the frequency 6 times and the next tube multiplies the frequency 3 times.

3. ELECTRON RAY INDICATOR TUBE.

a. When all of the circuits are tuned to resonance, the output will be greatest, causing the greatest r-f rectifier diode current to flow. The voltage drop across this diode load is applied to the electron ray indicator tube grid, which causes a deflection of the shadow to occur that is approximately proportional to the negative grid bias.

b. The triode portion of the electron ray indicator tube is constructed and behaves in a manner similar to any other triode tube. The target which is a cone-shaped fluorescent element located at the end of the tube, shows a green glow when electrons from the cathode strike it. It is connected to a source of constant high positive potential. A thin vane is located close to the cathode between the cathode and target, and is connected to the plate of the triode portion. Both the plate and the vane are connected to the high positive potential through resistance 477. This vane will then cause a shadow (part of the target not struck by electrons) the area of which is affected by the potential of the plate with respect to the target. Thus, when negative potential on the grid is increased, making the grid more negative, the plate current will decrease and decrease the voltage drop across resistor 477. This decreases the potential difference between the target and vane, causing the vane to have less effect on the electron stream between the cathode and target, making the shadow narrower. This condition exists when the tuning dial of Frequency Meter BC-638-A is set exactly to the correct output frequency for the crystal being used. Always tune for the smallest shadow.

SECTION V
MAINTENANCE

1. GENERAL.

Before removing a component from Frequency Meter BC-638-A, find out the cause of failure and the particular faulty component or circuit of the equipment. *Look for the simple causes of trouble first.* Remember that time can always be saved by finding out the *cause* of trouble and the sub-assembly or component that is to blame. *Study the complete schematic circuit diagram and check the various possible causes of failure.* When the bad unit has been detected, repair it, or replace with a good unit.

2. OPERATIONAL INSPECTION.

Inspect Frequency Meter BC-638-A thoroughly to determine whether the equipment is in proper working order. Make the operating tests while operating the frequency meter in conjunction with a receiver such as Radio Receiver BC-638-A. Make all other routine inspections or test checks only after removing the frequency meter from its mounting.

a. Make certain that all plugs are securely seated.

b. Check the power source with which the frequency meter is to operate. Remove the dust cover and check the position of plug 506 at the rear of the chassis.

c. The dial light should glow when power is supplied to the frequency meter. The tuning indicator in the lower left-hand corner will give off a bright green glow approximately one-half minute after power is supplied to the unit, and the "STAND BY-OPERATE" switch has been placed in the "OPERATE" position.

(1) If an a-c power source is used, the plug should be in the "LINE" receptacle 456-1.

(2) If an external power supply such as Dynamotor Unit PE-100-A is used to supply the necessary power, plug 506 should be in the "BATTERY" receptacle 456-2. Check the voltage at the four terminals for Dynamotor Unit PE-100-A (see fig. 6) at the back of the unit (under the dust cover). It should be 6.3 volts across the low voltage terminals and from 180 to 210 volts at the high voltage terminals with a variation of not more than 15 percent.

(3) If Dynamotor Unit PE-100-A is to be used, check the storage battery supplying this unit. Be certain it is fully charged and supplies at least 5.5 volts to the dynamotor unit.

3. DISASSEMBLY OF UNIT.

a. POWER AND ANTENNA CONNECTIONS.—To disconnect the power supply from the frequency meter remove either the line plug at the right rear, if an a-c power source is being used, or the four leads to the dynamotor unit, if Dynamotor Unit PE-100-A is being used.

A 12½-inch antenna rod is plugged into a socket mounted on the front panel of the frequency meter. To remove it from the socket, turn and pull it outward.

b. REMOVAL OF FREQUENCY METER BC-638-A FROM RACK.—Remove the four fillister head machine screws which pass through the two slots at each side of the front panel of the frequency meter, supporting the unit by the handles on the front panel while doing so. Grasp the handles and lift the unit out of the frame from the front.

c. REMOVAL OF DUST COVER FROM CHASSIS. Unscrew the two thumbscrews at the rear of the unit and slide the cover off.

d. REMOVAL FROM CASE CS-132.—Loosen the four knurled thumbscrews on the front panel and slide the unit from the case.

e. REMOVAL FROM CASE CY-33/CRC-2. — Loosen the four knurled thumbscrews on the front panel and slide the unit from the case.

f. R-F TUNING UNIT.

CAUTION

Only personnel thoroughly trained to repair the r-f tuning unit should maintain it. Wherever possible, perform maintenance on the r-f tuning unit by substituting a good unit for the defective r-f unit.

(1) Unsolder the 6-wire cable from the terminal board beneath the r-f tuning unit. (See fig. 10.) These wires are identified as follows:

(a) "B+ MOD." = blue wire.

(b) "FIL." = 2 brown wires.

(c) "GND." = black (directly to ground, marked "B" on terminal board).

(d) "B+" = yellow wire with black tracer.

(e) "EYE" = green.

(2) Unsolder the oscillator and grid bus wires from "OUTPUT CONTROL" switch 460. On some models, ordinary push-back wire is substituted for this grid bus wire.

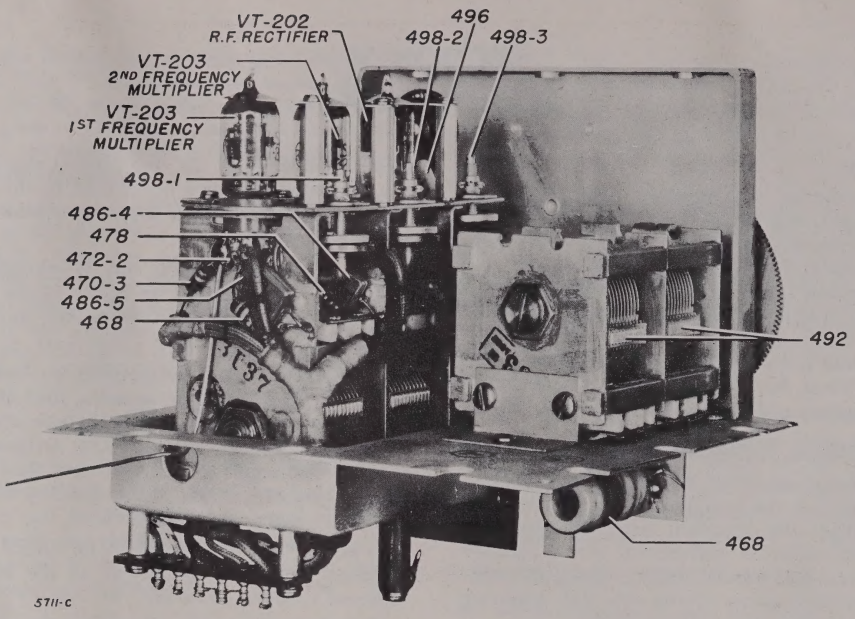


Figure 10 — Frequency Meter BC-638-A, R-F Tuning Unit—Rear Oblique View

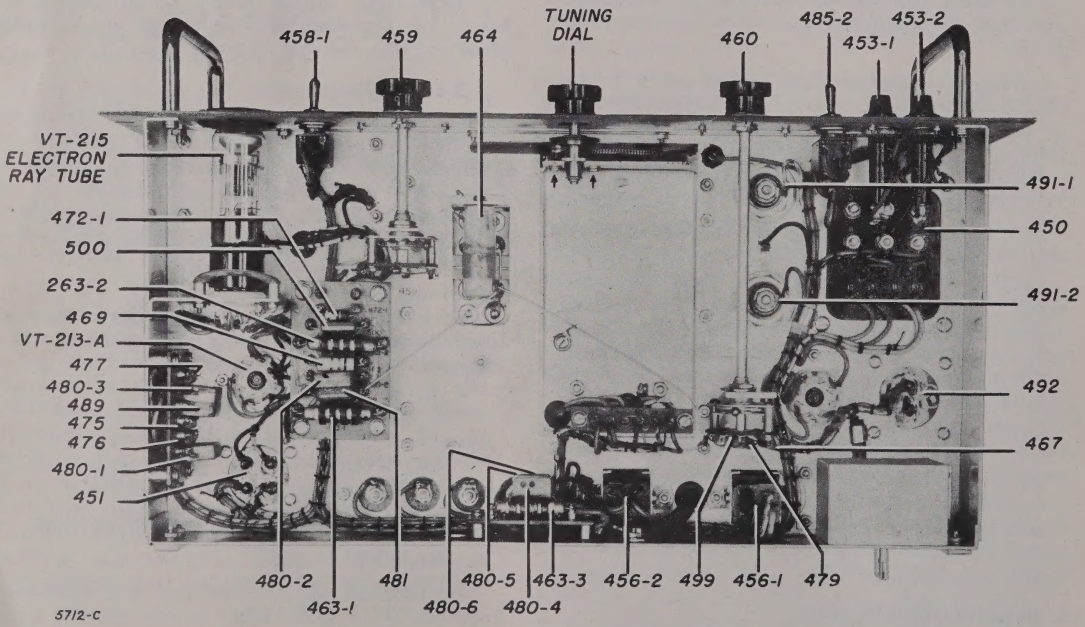


Figure 11 — Frequency Meter BC-638-A—Bottom View

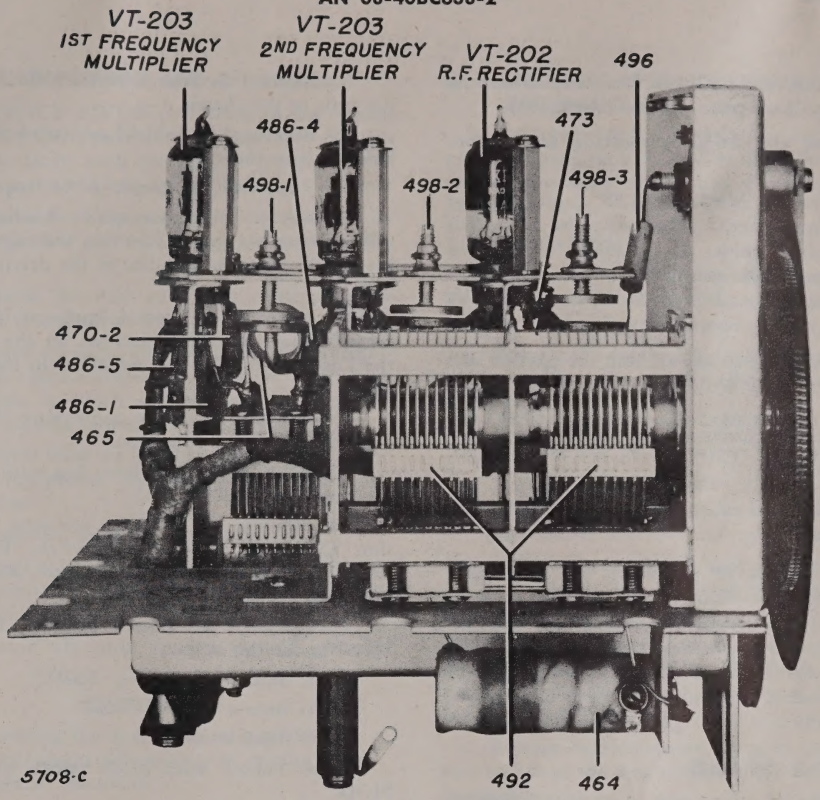


Figure 12 — Frequency Meter BC-638-A, R-F Tuning Unit—Left Side View

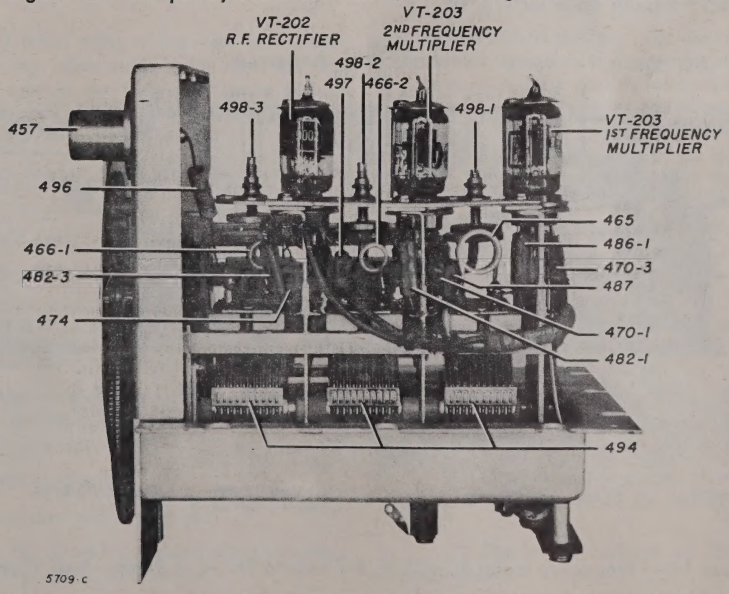


Figure 13 — Frequency Meter BC-638-A, R-F Tuning Unit—Right Side View

(3) Unsolder the oscillator bus wire from the wax covered oscillator plate coil 464 (see fig. 11).

(4) Remove the #6-32 supporting screw from micalex post.

(5) Remove the "MEGACYCLES" tuning control knob on the front panel by loosening the two Allen set screws in the shoulder of the knob. (The Allen wrench is located at the rear of the r-f shield and dust cover. Later models use Fahnstock clips as the holder for the Allen wrench instead of spring holders.)

(6) Remove the two screws from the friction dial driving assembly. See arrows, figure 11.

(7) Turn the chassis of the frequency meter over.

(8) Remove the twelve #6-32 screws in the r-f shield.

(9) Lift the rear end of the shield slightly, and slide backwards.

(10) Remove the four #6-32 screws (washers and nuts) at the corners of the unit.

(11) Lift front end of r-f tuning unit approximately ½ inch, and at the same time tilt it to the left (rear view) so that the antenna socket 457 will clear the dial light assembly. The unit can now be removed without any difficulty. (See figs. 12 and 13.)

4. REASSEMBLY OF UNIT.

a. Replace the r-f tuning unit in its proper position on the chassis. (See figs. 4 and 14.)

(1) Replace the four screws which hold the tuning unit to the chassis.

(2) Replace the r-f shield and fasten the 12 screws holding it to the unit.

(3) Turn over the chassis of the frequency meter.

(4) Replace the two screws holding the dial driving assembly, being sure that the edge of the dial fits snugly between this disc of the driving assembly. (See fig. 11.)

(5) Replace the control knob on its shaft and refasten the two Allen setscrews on the shoulder of the knob. Replace Allen wrenches in their clips for future use.

(6) Replace the screw supporting the oscillator bus wire on the micalex post.

(7) Resolder the oscillator bus wire to the wax oscillator coil. (See fig. 11.)

(8) Resolder the oscillator and grid bus wires to the "OUTPUT CONTROL" switch. Be sure that these leads are resoldered to the same terminals from which they were removed.

(9) Resolder the 6-wire cable to the terminal board under the chassis.

(a) Blue wire to "B+ MOD."

(b) Brown wires to "FIL."

(c) Black wires to "B–."

(d) Yellow with black tracer wire to "B+ MOD."

(e) Green wire to "EYE."

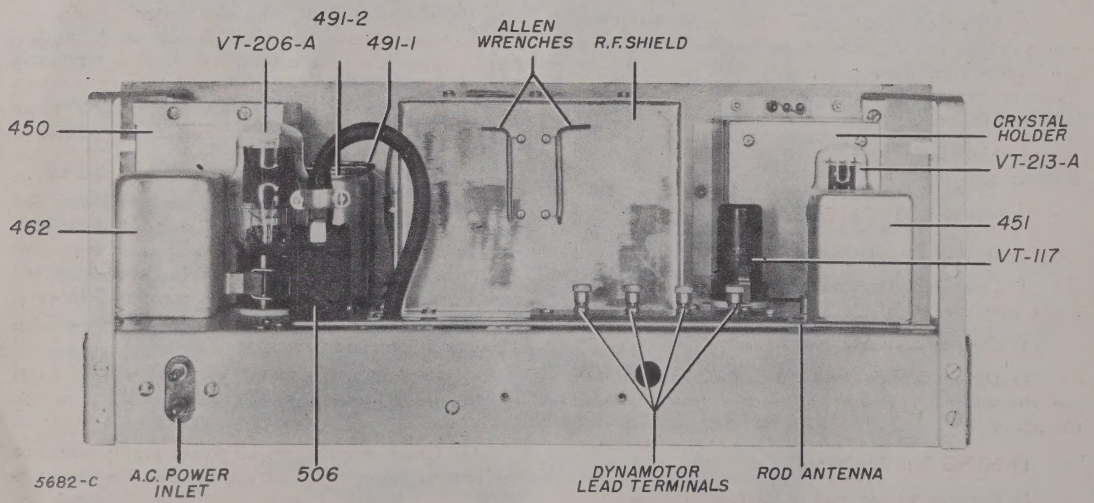


Figure 14 — Frequency Meter BC-638-A, R-F Tuning Shield in Place—Rear View

5. ROUTINE INSPECTION AND OVERHAUL.

a. FREQUENCY METER.—If there is any reason to suspect that performance is not normal, test this unit in accordance with paragraphs 8 and 9, this section. For a routine inspection proceed as follows:

(1) Remove the frequency meter from its rack by unscrewing the four screws holding the panel to the rack.

(2) Remove the dust cover by unscrewing the two knurled thumbscrews at the rear of the chassis.

(3) Inspect all nuts, bolts, and screws for tightness. Do not tighten glyptalled screws or nuts unless they are loose, in which case remove the screws or nuts, apply glyptal, replace, and tighten.

(4) Remove loose solder, dirt, and metallic chips. Clean the equipment thoroughly and touch up scratched paint.

(5) Remove all traces of corrosion.

(6) Inspect soldered joints and wiring. If more than two strands are broken at a soldered joint, resolder the connection.

(7) Remove all plug connectors and clean if necessary.

CAUTION

While making the above inspections, do not disturb alignment adjustments or wiring unless absolutely necessary.

b. TUBES.

(1) Check all tubes using a Supreme tube tester, model 504-A, or any other tube tester that will test the type of tube used in the frequency meter. Check them in accordance with the instructions provided vith the instrument.

(2) Make sure that all tubes are securely mounted in their sockets.

c. TUNING CAPACITORS.

(1) Inspect for dirt between the plates.

(2) Clean the plates carefully with a pipe cleaner, *being very careful not to bend the plates.*

(3) *Do not lubricate the capacitors.*

(4) *Do not blow out with air as the air hose may contain water or produce sufficient pressure to bend the plates.*

d. TUNING MECHANISM.

(1) Remove all dirt and old grease.

(2) Lubricate the gears and tuning shaft coupling as described in paragraph 7, this section.

6. INSPECTION AFTER OVERHAUL OF EQUIPMENT.

Repeat operational inspection according to details given in paragraph 2, this section, after making the routine checks or overhauling procedure outlined in paragraph 5.

7. LUBRICATION.

Do not lubricate the Variable Tuning Capacitor Trimmer Adjustments, or Controls. Lubricate the tuning gear mechanism as follows:

a. Remove the two knurled screws at the rear which hold the dust cover on the chassis; then remove the dust cover.

b. Lubricate the gear assembly with Royco 6A grease.

Note

Lubrication should not be necessary for approximately one year of normal operation.

There will be no danger of grease producing an effect on the tuned circuit; however, exercise the same care when lubricating the dial drive gears as when carrying out all other operations or maintenance procedures on Frequency Meter BC-638-A. *Never apply grease to the dial drive disc, for it depends upon friction for its operation.*

c. Replace the dust cover. Replace and tighten the two screws at the rear to hold the dust cover securely in position.

8. LOCATION AND REMEDY OF FAULTS.

a. GENERAL.—Open and short circuit faults can be found more easily if, instead of testing at random points, an orderly plan is followed. Use the schematic and wiring diagrams for guidance and test one portion of a circuit at a time. Measure the resistance from point to point with an ohmmeter, checking each element contained in that portion for open circuits, short circuits, and grounds. If the measured values of resistance are normal, as compared with the chart in paragraph 9, this section, that particular portion of the circuit is probably not at fault and needs no further attention. The identifying symbols of all components are given on the diagrams; their normal values can be determined by referring to Section VI, Table of Replaceable Parts.

b. TROUBLE LOCATION AND REMEDY. — If the frequency meter fails to operate, check it as follows:

(1) Check that the proper power supply source to the unit is being used. Be certain that the power is "ON."

(2) Check the settings of the controls on the front panel.

(3) Check that the radio receiver being used in conjunction with the frequency meter is functioning properly. If the trouble still persists, remove the dust cover of the frequency meter according to instructions in paragraph 3, this section, and carry out the following tests in the order given:

(a) Check that all tubes are securely seated in their respective sockets and that they glow when the power to the unit is "ON."

Note

The metal Tube VT-117 should become warm approximately five minutes after power is supplied to the unit.

(b) If any tube is believed defective, replace it with an identical tube known to be in good condition.

(c) Check the tube socket voltages according to the instructions in paragraph 9, this section.

(d) If any voltage reading does not check, disconnect the frequency meter and check the point-to-point resistance values according to instructions given in paragraph 9, this section.

(e) If, after a defect has been localized and the circuit components are found to be in good condition, the unit still does not function properly, check the wiring for continuity.

c. SYMPTOMS AND PROBABLE CAUSES.

Symptom	*Probable Causes*
1. Tuning indicator Tube VT-215 glows very dimly and is not easily perceptible. Output of unit satisfactory.	Defective indicator Tube VT-215 or defective rectifier Tube VT-202. Defective resistor(s) 473, 474, or 477. Defective capacitor 480-1 or 482-3.
2. Output of unit weak.	Not properly aligned. Defective tubes. Defective crystal. Try another crystal. Check "OUTPUT CONTROL" switch in "MAX." position. Defective capacitor 496 or 497.
3. Output is good over part of range, but unit will not function over remainder of range.	Defective crystal. Try another crystal. Defective oscillator Tube VT-117. (Check voltages to oscillator tube.)
4. Unit does not operate and tuning indicator does not glow green.	No plate voltage; check power supply if external supply is being used. Defective tubes; check voltages at sockets. Plug 506 not making good contact in socket. Open choke 463-3 or 462. Defective "STAND BY-OPERATE" switch 458-1. Defective resistor 477. Defective switch 458-2. Open choke 461-1 or 461-2. Blown fuses 453-1 or 453-2.
5. Fuses 453-1 and 453-2 continue to blow; or Tube VT-206-A frequently burns out.	Defective capacitors 491-1 and 491-2, 480-4 and 480-5. Defective choke 462.
6. No tubes light. Dial light does not light.	Open choke 461-1 or 461-2. Blown fuse 453-1 or 453-2. Defective transformer 450; check with a-c voltmeter. Defective "ON-OFF" switch 458-2. Check capacitor 480-6. Power off. Defective power inlet plug.
7. Tuning indicator indicates resonance, but output in radio receiver is very weak.	Open capacitor 496 or 497. Defective output socket 457 or broken lead to socket. Antenna touching panel.
8. Output satisfactory over band, but tuning indicator gives only slight indication of resonance.	Defective Tube VT-202. R-f rectifier trimming capacitor 498-3 not properly tuned to resonance. Defective capacitor 480-1 or 482-3. Defective resistor 477.
9. Tuning indicator indicates resonance, and carrier can be picked up in receiver but is not modulated by a 1000-cycle tone.	Defective transformer 451; check continuity of windings with an ohmmeter. Defective capacitor 480-3 or 489. Shorted capacitor 482-2. Defective Tube VT-213-A.
10. Tube socket resistance and voltage measurements are correct and unit is apparently properly aligned, but there is little or no output and tuning indicator does not indicate resonance.	Defective capacitor 497 or 496. Defective output socket 457. Defective Tubes VT-202 or VT-215.
11. Wavemeter indicates that crystal oscillator is functioning properly, but no first multiplier output is indicated on wavemeter.	Defective "OUTPUT CONTROL" switch. Defective capacitor 499. Defective first multiplier Tube VT-203. Defective resistor 468, 470-2, 470-3. Defective capacitor 486-1 or 486-2.

9. VOLTAGE AND RESISTANCE MEASUREMENTS.

a. TUBE SOCKET RESISTANCE MEASUREMENTS.—The values in Table I were taken from the tube socket terminal to ground (chassis) with an RCA voltohmyst junior. *They can be considered correct only* ± *10%* due to resistor and meter tolerances. The power source was disconnected, but the power change-over plug on the rear of the receiver was in the "LINE" receptacle. All values except those otherwise designated, were read on R x 10,000 scale. Any ohmmeter capable of measuring resistances as high as 600,000 ohms may be used. All readings were taken with tubes in their respective sockets, the readings being taken directly from the socket terminals. The controls on the front panel were set as follows:

(1) "STAND BY-OPERATE" switch at "STAND BY."

(2) "OUTPUT CONTROL" switch at "MAX."

(3) Power switch at "OFF."

TABLE I—TUBE SOCKET RESISTANCE MEASUREMENTS

		Tube Socket Terminals							
Tube	*Function*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
VT-202	R-f Rectifier	550,000	0	0	0	550,000	550,000	Inf.	—
VT-203	2nd Frequency Multiplier	160,000	* 525	0	0	Inf.	Inf.	N.C.	—
VT-203	1st Frequency Multiplier	160,000	*1100	0	0	Inf.	Inf.	N.C.	—
VT-213-A	1000-cycle Oscillator and Modulator	N.C.	0	Inf.	N.C.	65,000	N.C.	0	0
VT-117	Oscillator	0	0	31*	110,000	31*	Inf.	0	Inf.
VT-206-A	Power Rectifier	N.C.	Inf.	N.C.	Inf.	N.C.	Inf.	N.C.	Inf.
VT-215	Electron ray tube	0	Inf.	500,000	Inf.	0	0	—	—

* Values read on R x 10 Scale.

b. TUBE SOCKET VOLTAGE MEASUREMENTS.

(1) The voltages tabulated in Table II were obtained by measuring from the tube socket terminals to ground (chassis) with an RCA voltohmyst junior except as indicated by the sign †. Any vacuum tube voltmeter with an input resistance of 1 megohm or higher capable of measuring d-c voltages as high as 300 volts may be used. Use an a-c voltmeter in taking readings marked with an asterisk (*). The values were obtained with the frequency meter indicator set at 100 megacycles. A crystal whose fundamental frequency is 5555.55 kilocycles will be needed. Do not retune from 100 megacycles while taking the measurements. The controls were set in the following position. (The "B" supply was 203 volts, direct current.)

(a) "STAND BY-OPERATE" switch at "OPERATE."

(b) "OUTPUT CONTROL" switch at "MAX."

(c) Power switch at "ON."

(2) Allow the following tolerances for these measurements:

(a) Plate voltage (±10%).

(b) Screen voltages (±20%).

(c) Cathode voltages (±25%).

(d) Filament voltages (±15%).

(e) Grid voltages (±50%).

Note

Refer to the vacuum tube base wiring diagram, figure 19, to check which element of the tube is associated with each tube socket terminal.

Note

If the frequency meter is used with Dynamotor Unit PE-100-A, the filament voltages may be as low as 5.5 volts.

TABLE II—TUBE SOCKET VOLTAGE MEASUREMENTS

Tube	*Function*	*Tube Socket Terminals*							
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
VT-213-A	Mondulator	N.C.	0	201	N.C.	−19.5	N.C.	*6.25	Gnd.
VT-117	Oscillator	Gnd.	*6.25	0.25	−30	0.25	130	0	203
VT-203	1st Multiplier	−70	4.0	*6.25	Gnd.	203	60	N.C.	None
VT-203	2nd Multiplier	−3.0	2.0	*6.25	Gnd.	200	75	N.C.	None
VT-202	R-f Rectifier	−2.4	Gnd.	*6.25	Gnd.	−2.4	−2.4	N.C.	None
VT-215	Indicator	*6.25	50	−2.3	203	Gnd.	Gnd.	None	None
VT-206-A	Power Rectifier	N.C.	4.91†	N.C.	*180	N.C.	*180	N.C.	4.91†

* Use a-c voltmeter except when using Dynamotor Unit PE-100-A, then use d-c voltmeter.
† Place test leads of a-c voltmeter on terminals 2 and 8 to obtain this value.

c. POWER TRANSFORMER VOLTAGE MEASUREMENTS.—Be certain that the transformer is connected correctly for the supply voltage.

Supply Voltage	*Primary Terminal No. on Transformer*
110	2 and 3
120	1 and 3
200	2 and 4
210	1 and 4
220	2 and 5
230	1 and 5
240	2 and 6
250	1 and 6

With primary connected for available supply voltage, the secondary voltages should be as follows:

(Use an a-c voltmeter)

Voltage	*Terminals*
6.3	10 and 11
5	12 and 13
188	7 and 8
188	8 and 9
376	7 and 9

10. ALIGNMENT AND TRACKING PROCEDURES.

a. GEAR AND TUNING CAPACITOR ALIGNMENT.—The gears and dial must be assembled in the following order to prevent the dial stop from striking the ends of the gear loading springs and to insure correct dial reading (figs. 15 and 16).

(1) Mount the tuning dial pinion gear assembly. This assembly is held in place by a circular flange which is fastened to the front of the r-f tuning unit frame with two screws inserted from the rear. Refer to figure 15 for correct placement of the various parts.

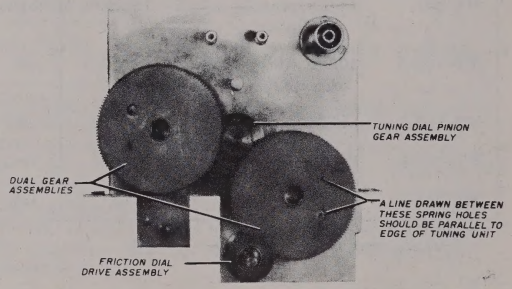

TUNING DIAL PINION GEAR ASSEMBLY
DUAL GEAR ASSEMBLIES
A LINE DRAWN BETWEEN THESE SPRING HOLES SHOULD BE PARALLEL TO EDGE OF TUNING UNIT
FRICTION DIAL DRIVE ASSEMBLY

Figure 15 — Frequency Meter BC-638-A, R-F Tuning Unit Gear Assemblies

(a) Before assembling the dual-gear assemblies with the tuning dial pinion gear, adjust the gear loading springs. To do this;

1. Hold the gear to which the hub is securely attached; at the same time turn the top gear of the same assembly counterclockwise three teeth.

2. While holding the gear assembly in this position, slip the hub onto the capacitor shaft; meanwhile engage the teeth of the assembly with the pinion gear.

3. Push the hub onto the capacitor shaft until it rests against the capacitor bearing, and then pull it away just enough to allow the assembly to rotate freely in either direction without touching the capacitor bearing assembly.

4. The gear hubs and loading springs must face the frame of the r-f tuning unit in order to align gears properly and prevent springs from striking dial

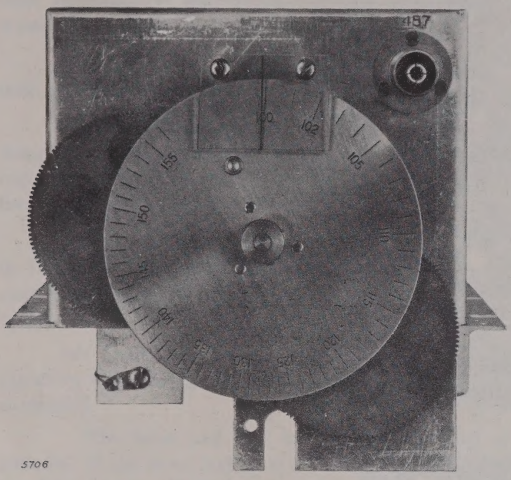


Figure 16 — Frequency Meter BC-638-A, Gear and Dial Assembly

stop. Do not tighten the set screws in the hub at this time.

5. Turn the gear assembly so that if a line were drawn between the loading spring holes, it would be parallel to the edge of the r-f tuning unit frame as shown in figure 15. Do not disturb this setting.

(b) Adjust the loading spring as described above on the remaining gear assembly and slip the hub onto the capacitor shaft. Engage the teeth with the pinion gear, remembering to have the line drawn between the loading spring holes parallel to the edge of the r-f tuning unit.

(2) Rotate the tuning dial pinion gear approximately 180 degrees. Tighten both gear assemblies to capacitor shafts, being sure that both capacitor gangs are fully meshed. Be sure that the gear hubs do not rub the capacitor bearing assembly. Adjust as described above if movement is not satisfactory. Use the Allen wrench supplied with the unit for this purpose.

(3) Slip the calibrated dial onto the shaft protruding from the tuning dial pinion gear until it rests against the pinion gear assembly, but do not tighten set screws. Assemble the friction dial driving assembly into the slot at the bottom of the tuning unit frame, making sure that the edge of the tuning dial fits snugly between the two discs attached to the shaft of this assembly. Secure in place with two screws from the rear. Rotate the dial to extreme clockwise position until it is against stop. Tighten the dial to the pinion shaft, making sure that both capacitor gangs are still fully meshed. *It is very important that both capacitor gangs be fully meshed* since a slight error will cause incorrect readings on the calibrated tuning dial.

(4) Replace the r-f tuning unit in its proper place on chassis as described in paragraph 4, *a,* this section.

(5) Lubricate gears sparingly with Royco #6A grease. (See par. 7 this sec.)

b. TRACKING PROCEDURE.—For the tracking procedure of the frequency meter set the controls as follows:

(1) Jones plug in "LINE" receptacle.

(2) "ON-OFF" switch to "ON."

(3) "STAND BY-OPERATE" switch to "OPERATE."

(4) "OUTPUT CONTROL" switch at "MAX." If a wavemeter is available, follow the tracking procedure outlined in method A; if a wavemeter is not available, follow the procedure outlined in method B.

CAUTION

Before attempting to adjust trimmers 498-1, 498-2, and 498-3, apply a solvent to glyptal-coated adjustment screws. This will free the screws, making adjustment easy. If this is not done, the screws will be damaged. Make these adjustments carefully, applying the least possible pressure to the trimmer screws, as excessive pressure will cause error in adjustments. Apply solvent sparingly. Allow approximately one minute for the glyptal to soften.

c. METHOD A.—Check the oscillator output of Frequency Meter BC-638-A as follows:

(1) Measure from the grid of the first multiplier Tube VT-203 to ground. This should be approximately —70 volts (±50%) when measured with the RCA voltohmyst junior.

(2) If a reasonable indication is not obtained from this measurement, check the oscillator circuit according to the instructions given in paragraphs 8 and 9, this section.

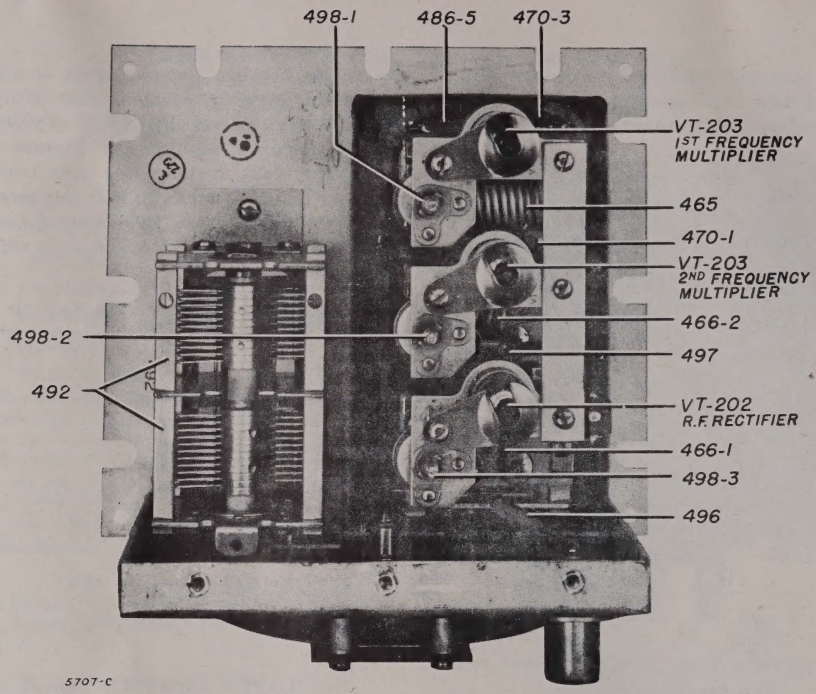


Figure 17 — Frequency Meter BC-638-A, R-F Tuning Unit—Top View

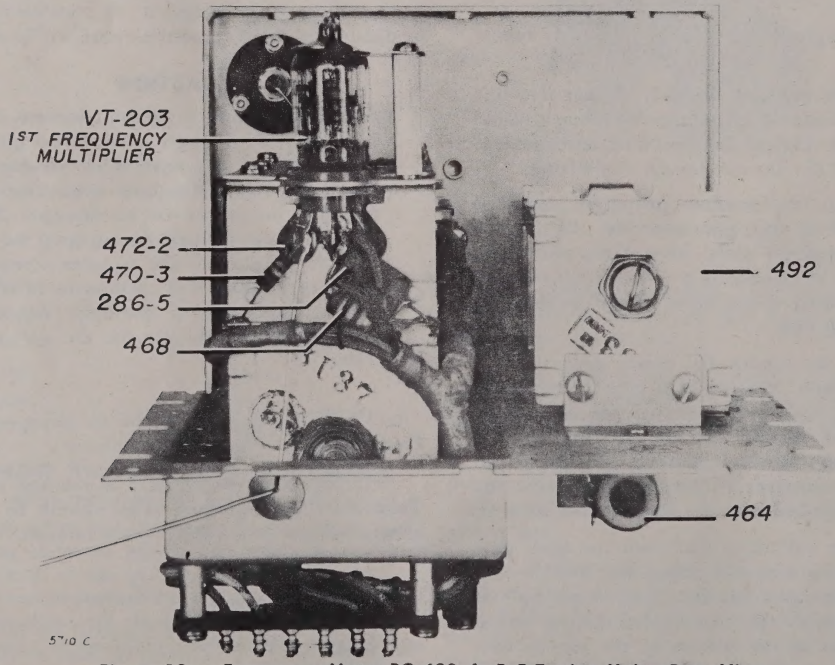


Figure 18 — Frequency Meter BC-638-A, R-F Tuning Unit—Rear View

(3) Check the first multiplier stage with the wavemeter supplied with the control set. The wavemeter is calibrated for the sixth harmonic of the oscillator fundamental band coverage which is approximately from 33 to 52 megacycles.

(a) Inductively couple the wavemeter to the tank coil of the first multiplier (465).

(b) Track this stage to the oscillator section as described below, using the 8666.66 and 5555.55 kilocycle crystals, which will set the extreme edges of the frequency meter coverage.

(c) Set the tuning dial of the frequency meter to 156 when using the 8666.66 kilocycle crystal, and tune the inductively-coupled wavemeter to 52 megacycles.

(d) Determine which way to turn trimmer capacitor 498-1 using the brass and iron tuning wand furnished.

The brass and iron tuning wand is used as follows. If the brass end of the wand is inserted into the field of any coil, it has the effect of lowering the inductance; hence the frequency of the coil is effectively increased. Upon inserting the iron end, the opposite effect occurs, that is, the inductance increases and the frequency decreases. These characteristics enable one to determine whether or not any given coil is properly tuned. If an increased deflection is obtained on the indicating device of the wavemeter when the brass end of the wand is inserted into the field of the coil, this indicates that the tuned circuit consisting of coil 465 and capacitors 498-1 and 494-A is tuned to too low a frequency and should be increased by reducing the capacity of trimmer condenser 498-1. An increased deflection when the iron end is introduced indicates that the trimmer capacity should be increased.

(e) Peak the high end of the band by adjusting trimmer 498-1 for maximum deflection of the thermo-coupled milliammeter which is mounted on the wavemeter. (See figs. 17 and 18.)

(f) Track the low end of the band, using the 5555.55 kilocycles crystal by varying inductor 465 for maximum deflection on the meter referred to above with the wavemeter tuned to 33 megacycles. Repeat this procedure several times if necessary until the first multiplier stage is accurately tracked to the tuning dial.

(g) Track the second multiplier and r-f rectifier stages at the high end of the band simultaneously by adjusting trimmer capacitors 498-2 and 498-3 for maximum output as indicated on the frequency meter tuning eye. Peak the low end of the band by varying the inductance of 466-1 and 466-2 to obtain the maximum output as indicated on the tuning eye. Maximum output is indicated on the tuning eye by making the gap close as much as possible.

(h) Retrack the second multiplier and rectifier stages until they are accurately tracked to the calibrated tuning dial.

(j) Install the tuning unit cover and recheck the tracking. In the later models of Frequency Meter BC-638-A, make final adjustments of the trimmers by removing the snap covers on the r-f tuning assembly shield which gives access to the trimmers.

d. METHOD B.—The following tracking procedure is carried out without the use of the wavemeter as described above.

(1) Before making any adjustments be sure the gear and tuning capacitor alignment is exactly correct.

(2) Check the tracking at three points: the low and high end of the band and some point near the middle of the band. Use the tuning eye as an output indicator and adjust for maximum closing of the gap.

CAUTION

Apply a solvent to glyptal-coated trimmer adjusting screws before attempting to make any adjustment, or these screws will be damaged.

(3) Set the frequency meter tuning dial to 156 megacycles when using an 8666.66 crystal and begin by adjusting trimmer 498-1 of the first multiplier for maximum output.

(4) Proceed by adjusting 498-2 and 498-3 of the second multiplier and r-f rectifier respectively for maximum output. Indications on the tuning eye may be very small when adjustments are started out but should increase as the adjustments proceed.

(5) When this adjustment is completed, set the tuning dial at 100 megacycles if a 5555.55 kilocycle crystal is used and vary inductor 465 of the first multiplier slightly by changing the distance between two adjacent turns of the inductor. Do this until maximum output is indicated.

(6) Proceed by adjusting the inductor 466-2 and 466-1 of the second multiplier and rectifier for maximum output.

(7) Repeat the tracking procedure for each stage until accurate tracking and maximum output is obtained.

(8) For another check on the accuracy of the tracking, insert a crystal whose frequency (x18) is near the center of the band and tune the frequency meter to the correct frequency, as indicated by the closing of the gap on the tuning eye. The frequency as read on the calibrated dial of the frequency meter should be the same as the crystal frequency multiplied by 18. Use an accurate Radio Receiver BC-639-( ) to aid in checking the adjustments just made on the frequency meter.

e. FINAL ADJUSTMENT.—After any test or repairs on the frequency meter, plug the antenna into socket 457 on the front panel and retrack the second multiplier and rectifier stages *with the antenna pointing downward.* Use the tuning eye as an output indicator. Track for maximum eye deflection. When the adjustments are accurate, apply glyptal to trimmer adjusting screws.

11. REPLACING DEFECTIVE COMPONENTS.

When a component is found to be defective, replace it with an identical component from the spare parts provided. Check with the data in the Table of Replaceable Parts to be sure that the component is properly identified. The new part must comply in every particular with the data contained therein.

a. Before removing a part from the unit, make a careful note of the leads connected to it and unsolder them. Bend the wires only as much as is necessary to remove the component. *Apply the soldering iron just long enough to soften the soldered joint.* Lengthy application of the soldering iron may loosen the terminal or other soldered joints on adjacent components.

b. Components can be removed with a screw driver, pliers, and soldering iron. Washers are provided with all screws. *Always replace the washer between the head of the screw and the face of the panel or chassis.*

c. When putting in new parts, use the same screws used for the old part whenever they are in good condition. *Be careful in tightening the screws not to strip the threads.*

d. Use only resin core solder or special flux intended for radio use. *NEVER USE PASTE OR ACID FLUX.*

e. Clean and tin *both* terminal and wire before attempting to make a connection. Fasten the wire mechanically by twisting it around the terminal and clip the surplus before soldering. Heat the wire and terminal so the solder will flow into the joint. Remove any excess solder so that it will not cause future short circuits and grounds. *AFTER SOLDERING, DO NOT DISTURB THE JOINT UNTIL IT COOLS.*

f. Do not attempt maintenance of switches and r-f tuning unit in the field. All repairs of this unit must be made only by trained personnel equipped with specific maintenance instructions, test equipment, and tools for this purpose. If the unit fails to operate properly, notify the maintenance depot and do not attempt further use of it until it has been properly repaired.

12. OVER-ALL PERFORMANCE TEST.

a. GENERAL.—If at any time the performance of the frequency meter is doubtful, check as outlined in *b* and *c* below. Make this check also after any major repairs or adjustments. The performance obtained as a result of these measurements should conform to the normal performance characteristics given below.

b. STANDARD TEST CONDITIONS.—For all of the individual performance tests, unless otherwise stated, the following standard test conditions must be maintained:

(1) INPUT POWER VOLTAGE.—110, 120, 200, 210, 220, 230, 240, or 250 volts alternating current, 50-60 cycles at 35 watts, whichever is suitable. (The power transformer tap will be set for a normal input voltage of 230 volts a-c.) For battery operation (6-volt battery in conjunction with Dynamotor Unit PE-100-A) a minimum of 5.5 volts, at 6 amperes $\pm 15\%$.

(2) WARM-UP PERIOD.—One minute unless otherwise stated.

(3) "STAND BY-OPERATE" SWITCH. — To "OPERATE" unless otherwise stated.

(4) "OUTPUT CONTROL."—To "MAX" unless otherwise stated.

(5) "ON-OFF SWITCH." — To "ON" unless otherwise stated.

(6) DUST COVER OF FREQUENCY METER.—The dust cover shall be in its proper position when using the frequency meter for any frequency or alignment check on a receiver.

c. METHODS OF MEASUREMENT. — To make the performance tests, make each measurement as described in the text below.

(1) MODULATION TEST. — Set up the frequency meter for operation. Turn on and tune Radio Receiver BC-639-( ). *Make certain the beat frequency oscillator is off by putting the "C.W. AND MANUAL-MANUAL-AVC" switch in either "MANUAL" or "AVC" position.* Tune Radio Receiver BC-639-( ) to the frequency being emitted by Frequency Meter BC-638-A. As this frequency is approached, an approximate 1000-cycle note should be heard in the receiver. If it is necessary to turn the receiver beat frequency oscillator "ON" in order to receive the signal from the frequency meter, then modulation of the frequency meter signal is not taking place. Follow the test procedure in paragraphs 8 and 9, this section.

(2) MODULATING FREQUENCY TEST.—The purpose of this test is to determine the modulator frequency of Frequency Meter BC-638-A, which should be 1000 cycles per second, ±10 percent.

(a) With the beat frequency oscillator on Radio Receiver BC-639-( ) off (obtained by turning "C.W. AND MANUAL-MANUAL-AVC" switch to the "MANUAL" position), plug a headset into Radio Receiver BC-639-( ) and tune in a signal from Frequency Meter BC-638-A on the radio receiver. Any crystal may be used in the frequency meter that will give an output signal within the range of the radio receiver.

(b) Place another headset across the output of any audio signal generator, such as the Hewlett-Packard model 205A. Turn the signal generator "ON" and after allowing a reasonable period for warm-up, tune it to 1000 cycles.

(c) Place together both pairs of headsets on any convenient table and raise the volume in each to an equal level. Do not raise the respective gains too much as it will be difficult to notice the desired effect.

(d) Now slowly tune the audio signal generator through the 1000-cycle setting and listen to the resultant combined signal from the two pairs of head sets. By listening carefully, a superimposed fluttering or beat note (two signals relatively close in frequency) will be noted. As they approach each other in frequency, the beat note will lower in frequency until the separate pulsations can actually be counted. Carefully tune the audio signal generator until the beat note either dies out or is of a very low value, not more than one beat per second.

(e) The frequency indicated on the audio signal generator which produced this condition should be 1000 cycles per second, ±10 percent.

(3) OUTPUT VOLTAGE ATTENUATION CHECK.—Check for operation with the "OUTPUT CONTROL" switch at "MIN" by listening to the signal from Radio Receiver BC-639-A. The "OUTPUT CONTROL" switch should give a definite attenuation when switched from "MAX" to "MED" to "MIN." Due to the intense signal from the frequency meter, the receiver output may not vary appreciably when the frequency meter "OUTPUT CONTROL" setting is changed. If this becomes apparent, decrease the r-f gain control setting of the receiver and again check the attenuation settings.

(4) POWER SUPPLY RIPPLE. — Check the power supply ripple by connecting a Ballantine model 300-A vacuum tube voltmeter (or any vacuum tube voltmeter with a capacitor in series with the input) to the filtered "B" voltage in the frequency meter. This voltage may be measured at terminal 4 on socket 503. The a-c component in the "B" voltage should not exceed 2 percent with a normal load at 210 volts.

13. VACUUM TUBE REPLACEMENT.

a. Locate vacuum tubes as described in section II, paragraph 3, *a.*

b. All tubes but the electron ray Tube VT-215 may be replaced from the top of the chassis. The latter must be replaced from the bottom of the chassis.

c. Note that each tube has a retaining clamp. Release this clamp before attempting to remove a tube from its socket.

14. DIAL LIGHT REPLACEMENT.

a. Remove the two knurled knobs holding the dust cover on the chassis. Then remove the dust cover.

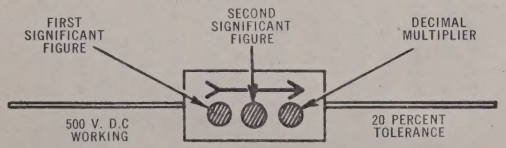
b. Remove the burned out bulb, which is a bayonet base type. Do this by pushing the bulb slightly into the socket at same time turning it counterclockwise approximately 1/8 inch, and then pulling straight away from socket.

c. Replace with a new 6-8-volt, 0.25-ampere bayonet base bulb, Mazda #44.

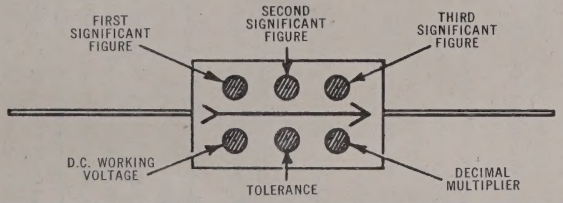
d. Replace the dust cover and tighten the two knurled knobs.

TABLE III—COLOR CODES

CAPACITORS (MMFD)



COLOR	NUMERAL	VOLTS	MULTIPLIER	TOLERANCE
BLACK	0		1	
BROWN	1	100	10	1%
RED	2	200	100	2%
ORANGE	3	300	1,000	3%
YELLOW	4	400	10,000	4%
GREEN	5	500	100,000	5%
BLUE	6	600	1,000,000	6%
VIOLET	7	700	10,000,000	7%
GRAY	8	800	100,000,000	8%
WHITE	9	900	1,000,000,000	9%
GOLD		1000	0.1	5%
SILVER		2000	0.01	10%
NO COLOR		500		20%

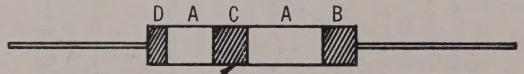


RESISTORS (OHMS)

COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER
SILVER			0.01
GOLD			0.1
BLACK		0	1.0
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
PURPLE	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	

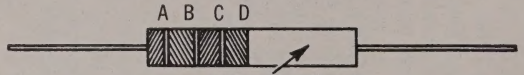
D — TOLERANCE CODE:

GOLD = 5% SILVER = 10% NO COLOR = 20%.



BAND OR DOT

OLD COLOR ARRANGEMENT



BODY COLOR

NEW COLOR ARRANGEMENT

BODY COLOR (NEW COLOR ARRANGEMENT ONLY) INDICATES TYPE OF RESISTOR, AS FOLLOWS:

BLACK - COMPOSITION, NON-INSULATED
TAN, OLIVE OR WHITE - COMPOSITION, INSULATED
DARK BROWN - WIRE-WOUND, INSULATED

SECTION VI
TABLE OF REPLACEABLE PARTS

MODEL: FREQUENCY METER BC-638-A

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
450	2Z10000-30	TRANSFORMER: primary: 50-60 cycles a-c; terminals 2 and 2 110 volts, 1 and 3 120 volts, 2 and 4 200 volts, 1 and 4 210 volts, 2 and 5 220 volts, 1 and 5 230 volts, 2 and 6 240 volts, 1 and 6 250 volts; rating is 26 volt-amps; secondary: terminals 10 and 11 6.3 volts at 1.45 amperes, 12 and 13 5 volts at 2 amperes, 7 and 9 376 volts at .25 amperes rectified, center tapped at terminal 8; case, 3½″ x 3-3/16″ x 4-¼″.	Power	Bendix Radio	A103030
451	2Z10000-62	TRANSFORMER: primary: terminals 1 and 2, 625 ohms resistance; secondary: terminals 3 and 4, 250 ohms resistance; turns ratio primary to secondary, 3 to 1; inductance primary and secondary in series, 4.83 henries; frequency 500 and 1000 cycles; case, 1⅞″ x 7/16″ x 2⅝″.	Audio	Bendix Radio	A103062
453-1	3Z1946	FUSE: 0.5 amperes, 250-500 volts, Bussman type 3AG½ Littelfuse cat. no. 1046; cartridge type, 1¼″ long, ¼″ dia.	A-C line	Littelfuse Labs. and Bussman Mfg.	A11302-23
453-2		FUSE: same as 453-1.			
	3Z3285-1 or 3Z3275	FUSEHOLDER: panel mounting type, Bussman type HKM for 3AG fuse, Littlefuse cat. no. 1075-A.	Fuse holder	Bussman Littel	A110528-1 or A30003
454	2Z5927	LAMP: 6-8 volts, 0.025 amperes bayonet base bulb; model ATU-26 Mazda type 44.	Illuminate dial	General Electric	A9320-1
455	2Z8723.2	SOCKET: for bayonet base type bulb.	Dial light	Am. Radio Hardware	A105146
456-1	2Z8639-1	SOCKET: 4-contact socket with tabs for mounting on chassis; type S-404-AB modified.	A-C power	Howard B. Jones	A105130
456-2		SOCKET: same as 456-1.	Battery power		
457	2Z8689	SOCKET: output coupling.	Output	Bendix Radio	C57840
458-1	3Z9857.7	SWITCH: DPST toggle; 3 amperes, 250 volts.	Stand by-Operate	Arrow Hart and Hegeman	A104876
458-2		SWITCH: same as 458-1.	Power On-Off		

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
459	3Z9827.23	SWITCH: single pole, 5-position, type H, rotary switch with shaft 2½″ long, ¼″ dia.	Crystal selector	Oak Mfg.	C58499
460	3Z8306-1	SWITCH: single pole, 3-position, type H, rotary switch with shaft 5-13/16″ long, ¼″ dia.	Attenuator	Oak Mfg.	C58500
461-1	3C336-11	INDUCTOR: high frequency choke, d-c current rating 1000 ma; resonates at 18 mc with 35 mmfd, minimum Q is 65. D-C resistance is less than ½ ohm.	R-F choke	Ohmite Mfg.	A104090
461-2		INDUCTOR: same as 461-1.	R-F choke		
462	3C336-8	INDUCTOR: 30 h, 0.025 amperes d-c, 870 ohms at 20°C.	Filter choke	Bendix Radio	A27098
463-1	3C336-10	INDUCTOR: 1.7 mh ±3%, 40 ohms maximum d-c resistance.	R-F choke	Coto-Coil	A1666-1
463-2		INDUCTOR: same as 463-1.			
463-3		INDUCTOR: same as 463-1.			
464	3C336-22	COIL ASSEMBLY: 25½ turns No. 28 DCC solid copper wire, 7.5 mmh.	Osc. plate	Bendix Radio	AC58685
465	3F2993-4	INDUCTOR: 8½ turns No. 14 A.W.G. (0.064), silver plated, 9/16″ outside dia., ⅞″ long. silver-plated.	1st multiplier plate	Bendix Radio	A105080
466-1	3F2993-5	INDUCTOR: 3 turns No. 14 A.W.G. (0.064), ⅜″ outside dia., ⅝″ long, silver plated.	Output coil	Bendix Radio	A105081
466-2		INDUCTOR: same as 466-1.			
467	3Z6020-18	RESISTOR: 200 ohms ±5%, ½ watt, ceramic; insulated; 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Attenuator	Erie Resistor (Alternate: AWS type RC20BF201J)	A18001-201
468	3Z6100-42	RESISTOR: 1000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	1st multiplier cathode	Erie Resistor (Alternate: AWS type RC20BF102J)	A18001-102
469	3Z6640-13	RESISTOR: 40,000 ohms ±5%, 1.0 watt, ceramic insulated; ¾″ long, 9/32″ dia., 1½″ leads, type 518.	Osc. screen series	Erie Resistor (Alternate: AWS type RC30BF393J)	A18158-403

470-1	3Z6715-13	RESISTOR: 150,000 ohms ±5%, ½ watt, ceramic insulated; 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	2nd multiplier grid	Erie Resistor (Alternate: AWS type RC20BF154J)	A18001-154
470-2		RESISTOR: same as 470-1.	1st multiplier screen series		
470-3		RESISTOR: same as 470-1.	1st multiplier grid		
472-1	3Z6700-9	RESISTOR: 100,000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Osc. Grid Leak	Erie Resistor (Alternate: AWS type RC20BF104J)	A18001-104
472-2		RESISTOR: same as 472-1.	2nd multiplier screen dropping		
473	3Z6750-6	RESISTOR: 500,000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Output plate load	Erie Resistor (Alternate: AWS type RC20BF474J)	A18001-504
474	3Z6630-13	RESISTOR: 30,000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Indicator grid coupling	Erie Resistor (Alternate: AWS type RC20BF303J)	A18001-303
475	3Z6610-44	RESISTOR: 10,000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Audio Osc. grid feedback	Erie Resistor (Alternate: AWS type RC20BF103J)	A18001-103
476	3Z6660-4	RESISTOR: 60,000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Audio osc. and mod. grid	Erie Resistor (Alternate: AWS type RC20BF623J)	A18001-603
477	3Z6801-3	RESISTOR: 1.0 megohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Indicator Target	Erie Resistor (Alternate: AWS type RC20BF105J)	A18001-105
478	3Z6050-32	RESISTOR: 500 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	2nd multiplier cathode	Erie Resistor (Alternate: AWS type RC20BF471J)	A18001-501
479	3Z6200-28	RESISTOR: 2000 ohms ±5%, ½ watt, ceramic insulated, 7/16″ long, 7/32″ dia., 1½″ leads, type 504.	Attenuator	Erie Resistor (Alternate: AWS type RC20BF202J)	A18001-202
480-1	3DA10-87	CAPACITOR: 0.01 mf. ±5%, 300 volts d-c working, Aerovox type 1467 or C.D. type 1WL; mica dielectric; low-loss insulation size ¾″ x ¾″ x ¼″ with 1¼″ leads.	R-F bypass	Cornell-Dublier or Aerovox	C56311-103

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
480-2		CAPACITOR: same as 480-1.	Osc. screen bypass		
480-3		CAPACITOR: same as 480-1.	Audio tuning		
480-4		CAPACITOR: same as 480-1.	R-F bypass		
480-5		CAPACITOR: same as 480-1.	R-F bypass		
480-6		CAPACITOR: same as 480-1.	R-F bypass		
481	3K3030212	CAPACITOR: 0.003 mf. ±5%, 500 volts d-c working, Aerovox type 1467 or C.D. type 1WL; mica dielectric; low-loss insulation; size ¾" x ¾" x ¼" with 1¼" leads.	Crystal Osc. Coupling	Cornell-Dublier or Aerovox (Alternate: AWS type CM30A302J)	C56311-302
482-1	3D9100-49	CAPACITOR: 100 mf. ±5%, 500 volts d-c working, Aerovox type 1468 or C.D. type 5WL; mica dielectric; low-loss insulation; size 11/16" x 7/16" x 3/16" with 1¼" leads.	2nd multiplier screen bypass	Cornell-Dublier or Aerovox (Alternate: AWS type CM20B101J)	C56314-101
482-2		CAPACITOR: same as 482-1.	Audio osc. and mod. plate R-F bypass		
482-3		CAPACITOR: same as 482-1.	R-F bypass		
483-1	3DA2-61	CAPACITOR: 0.002 mf. ±5%, 500 volts d-c working, Aerovox type 1467 or C.D. type 1WL; mica dielectric; low-loss insulation; size ¾" x ¾" x ¼" with 1¼" leads.	A-C line Input filter	Cornell-Dublier or Aerovox (Alternate: AWS type CM30B202J)	C56311-202
483-2		CAPACITOR: same as 483-1.	A-C line input filter		
486-1	3D9500-50	CAPACITOR: 500 mmf. ±5%, 500 volt d-c working, Aerovox type 1468 or type 5WL, mica dielectric, low-loss insulation; size 11/16" x 7/16" x 3/16" with 1¼" leads.	1st multiplier screen bypass	Cornell-Dublier or Aerovox (Alternate: AWS type CM20B511J)	C56314-501
486-2		CAPACITOR: same as 486-1.	1st multiplier supply bypass		

486-3		CAPACITOR: same as 486-1.	Output tank R-F bypass		
486-4		CAPACITOR: same as 486-1.	2nd multiplier cathode bypass		
486-5		CAPACITOR: same as 486-1.	1st multiplier cathode bypass		
487	3D9015-6	CAPACITOR: 15 mmf. ±1.5 mmf. 500 volts d-c working; type N680K ceramicon; 7/16" long, .215" dia.; leads 1½" long.	2nd multiplier grid coupling	Erie Resistor	A18182-9
489	3DA5-27	CAPACITOR: 0.005 mf. ±5%, 500 volts d-c working, Aerovox type 1467 or C.D. type 1WL; mica dielectric; low-loss insulation; size ¾" x ¾" x ¼", leads 1¼" long.	Audio osc. grid coupling	Cornell-Dublier or Aerovox (Alternate: AWS type CM30B512J)	C56311-502
491-1	3DB2.6020	CAPACITOR: 2 mf., 600 volts d-c working; dykanol, cat. no. TLA-6020.	Filter	Cornell-Dublier	A30322
491-2		CAPACITOR: same as 491-1.			
492	2C1540-638A/C2	CAPACITOR: variable 2-section 6 to 42 mmf. per section with 0 to 100% rotation.	Osc. plate tuning	General Industries	L73193
494	2C1540-638A/C1	CAPACITOR: variable 3-section, 6 to 42 mmf. per section with 0 to 100% rotation.	R-F tuning	General Industries	L73191
496	3D9010-5	CAPACITOR: 10 mmf ±1 mmf, 500 volts d-c working, type N6806 ceramicon; 11/16" long, .215 dia.; leads 1½" long.	Output coupling	Erie Resistor	A18182-3
497	3D9020-4	CAPACITOR: 20 mmf ±1 mmf, type N750	2nd multiplier coupling	Erie Resistor	A18182-10
498-1	3D9012V-7	CAPACITOR: Trimmer assemblies, upper and lower, 1.5—12 mmf, part of assembly AN-91072-1.	1st multiplier trimmer	Bendix Radio	A107044-1 A107045-1
498-2		CAPACITOR: same as 498-1.	2nd multiplier trimmer		
498-3		CAPACITOR: same as 498-1.	Output trimmer		
499	3DA1-54	CAPACITOR: 1000 mmf. ±5%, 500 volts d-c working; Aerovox type 1468 or C.D. type 5WL; mica dielectric; low-loss insulation, size 11/16" x 7/16" x 3/16" with 1¼" leads.	1st multiplier grid coupling	Cornell-Dublier or Aerovox (Alternate: AWS type CM30B102J)	C56314-102

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
500	3D9025-23	CAPACITOR: 25 mmf. ±2%, 500 volts d-c working, Aerovox type 1468 or C.D. type 5WL; mica dielectric; low-loss insulation; size 11/16" x 7/16" x 3/16" with 1¼" leads.	Crystal freq. compensator	Cornell-Dublier or Aerovox	C56313-250
501-1	2Z8762-2	SOCKET: 8-pin type, cat. no. 558	Vacuum tube	American Phenolic	A18168-6
501-2		SOCKET: same as 501-1.			
501-3		SOCKET: same as 501-1.			
502-1	2Z8657-3	SOCKET: 7-pin, miniature, type 78-7 pt.	Vacuum tube	American Phenolic	A102980
502-2		SOCKET: same as 502-1.			
502-3		SOCKET: same as 502-1.			
503	2Z8657-2	SOCKET: 6-pin type, cat. no. 556	Vacuum tube	American Phenolic	A18168-3
504	2C1540-638A/B9	BOARD: 5-operating, 1-spare crystal mounting.	Crystal holder	Bendix Radio	AC58614
506	2Z8639-2	PLUG: 4-contact male, type P-404-CCT (modified).	A-C-D-C power selector	Howard B. Jones	A105131
	2J6SK7	TUBE: JAN-6SK7 (VT-117).	Oscillator	R.C.A. or Kenrad	
	2J9003	TUBE: JAN-9003 (VT-203).	1st freq. multiplier	R.C.A. or Kenrad tube & lamp	
	2J9003	TUBE: JAN-9003 (VT-203).	2nd freq. multiplier	R.C.A. or Kenrad tube & lamp	
	2J9002	TUBE: JAN-9002 (VT-202).	R-F rectifier	R.C.S. or Kenrad tube & lamp	
	2J6E5	TUBE: JAN-6E5 (VT-215).	Electron ray tube	R.C.A. or Kenrad tube & lamp	
	2J6L5G	TUBE: JAN-6L5G (VT-213-A).	1000-cycle osc. & modulator	R.C.A. or Kenrad tube & lamp	
	2J5V4G	TUBE: JAN-5V4G (VT-206-A).	Power rectifier	R.C.A. or Kenrad tube & lamp	

2Z3501-11A	CRYSTALS: crystal holder with 5 crystal (5555.55 to 8666.6 kilocycles) cover the operating range of 100 to 156 megacycles.	Crystal frequencies	Bendix Radio	AL72946
2A3190	AERIAL ROD ASSEMBLY: 12½ inches long.	Receiver coupling	Bendix Radio	AA106073-1
2C1540-638A/B5	OSCILLATOR BOARD ASSEMBLY: contains 500, 481, 480-2, 469, 472-1, 463-1, 463-2.	Osc. assembly	Bendix Radio	AC58469-1
2C1540-638A/B6	BOARD ASSEMBLY: contains 489, 480-1, 480-3, 476, 477, 475.	Modulator and eye assembly	Bendix Radio	AC58630-1
2C1540-638A/B7	LINE FILTER ASSEMBLY: contains 461-1, 461-2, 483-1, 483-2.	Line filter assembly	Bendix Radio	AC58628-1
2C1540-638A/B8	BOARD: contains 480-4, 480-5, 480-6, 463-3.	Filter assembly	Bendix Radio	AA105142-1
6R57400	WRENCH: for No. 8 Allen setscrew.	Setcrew	Allen Mfg.	A18190-8
6R57400-6	WRENCH: for No. 6 Allen setscrew.	Setscrew	Allen Mfg.	A18190-6
2Z5854	POINTER AND KNOB ASSEMBLY.	Crystal selector	Bendix Radio	AA104855-1
2Z5854	POINTER AND KNOB ASSEMBLY.	Output attenuator	Bendix Radio	AA104855-1
2Z5822	KNOBS: black phenolic No. S-308-3.	Control knobs	Kurz-Kasch	A102617
2Z7097-3	PLATE INSULATING ASSEMBLY: Phenolic plate; 1-13/32″ dia. x ⅛″ thick with single contact socket.	Output socket	Bendix	C58585-1
2Z9404.74	TERMINAL BOARD ASSEMBLY: 6″ long x 1″ wide x ¼″ thick; 4 posts; etched from left to right; H.V.+; H.V.−; L.V.+, and L.V.−.	External connections to unit	Bendix	A105126
3Z3275	FUSEHOLDER: type No. 1075A.	Fuse mounting	Littelfuse	A30003
2C1540-638A/T1	TUNING UNIT ASSEMBLY	Main tuning unit	Bendix	AN91062-1

SECTION VII
DRAWINGS

CODE	ELEMENT
G_1	CONTROL GRID
G_2	SCREEN GRID
G_3	SUPPRESSOR GRID
H	HEATER
K	CATHODE
NC.	NO CONNECTION
P	PLATE (ANODE)
S	SHELL
T	TARGET

Figure 19 — Frequency Meter BC-638-A, Vacuum Tube Base Diagram

CODE	ELEMENT
G_1	CONTROL GRID
G_2	SCREEN GRID
G_3	SUPPRESSOR GRID
H	HEATER
K	CATHODE
NC.	NO CONNECTION
P	PLATE (ANODE)
S	SHELL
T	TARGET

Figure 19 — Frequency Meter BC-638-A, Vacuum Tube Base Diagram

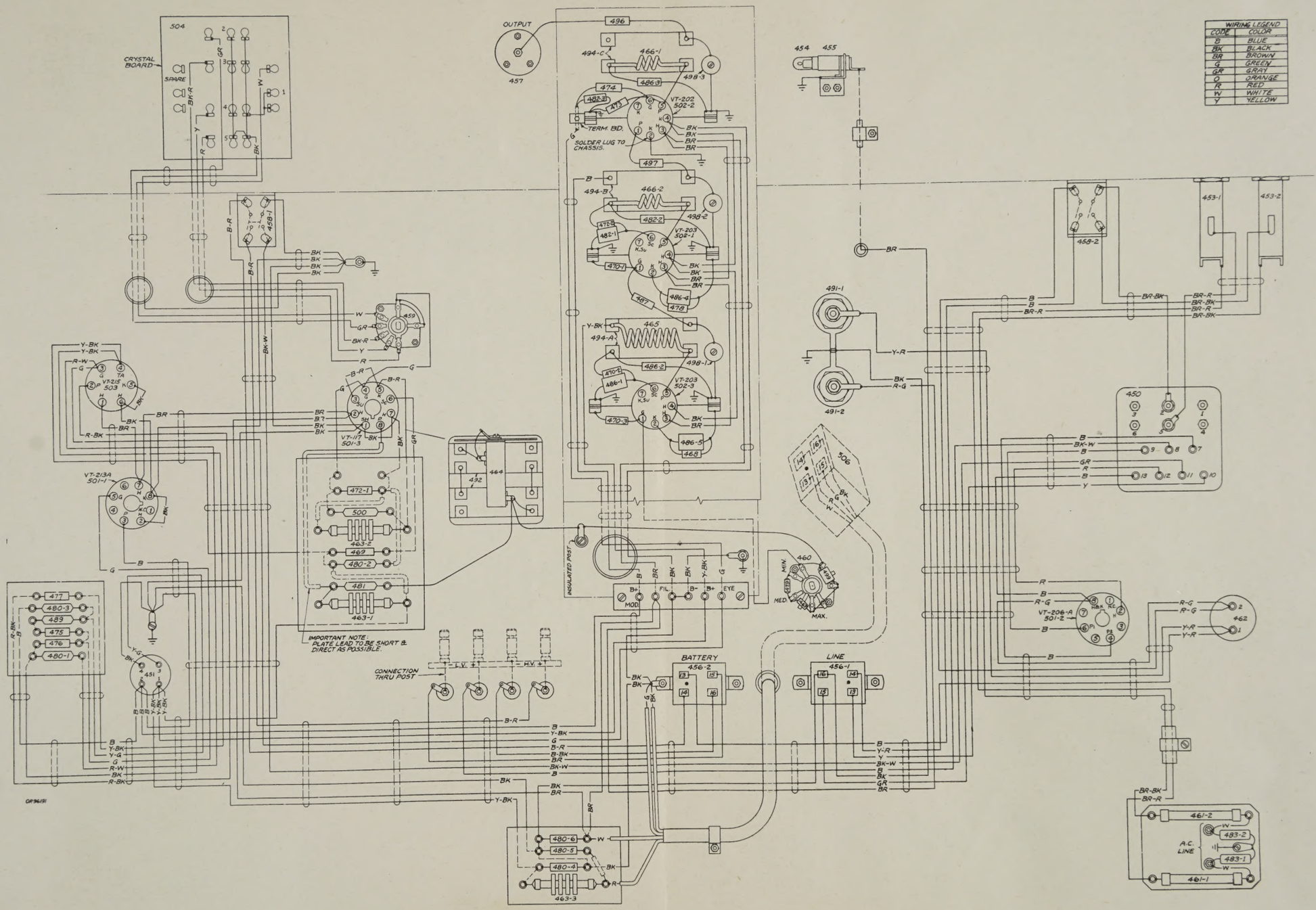


Figure 20 — Frequency Meter BC-638-A, Wiring Diagram

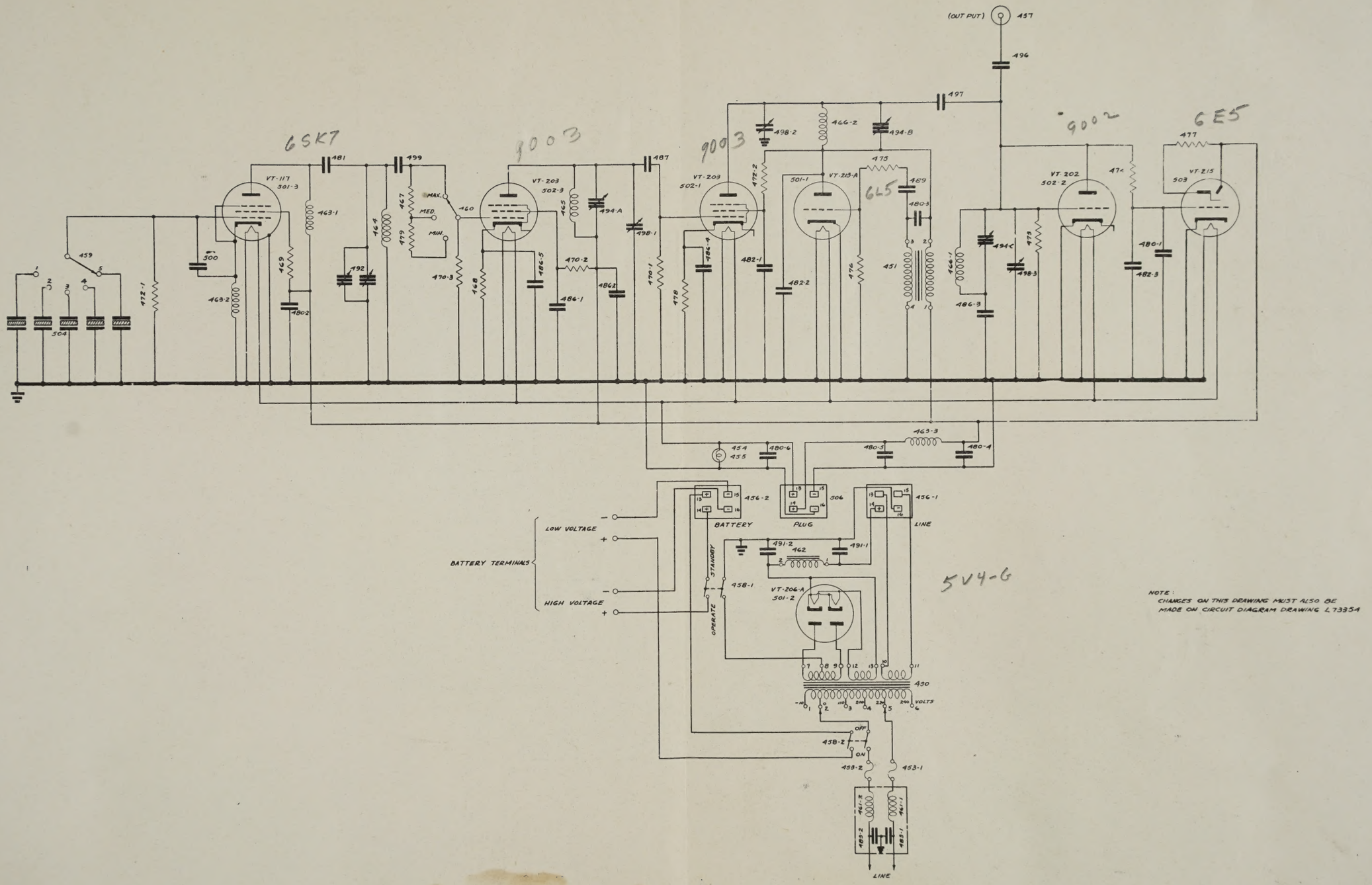


Figure 21 — Frequency Meter BC-638-A. Schematic Diagram